

LOW IMPACT DEVELOPMENT

LOCAL REGULATION ASSISTANCE PROJECT 2009

PREPARED BY:



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FOR: Puget Sound Partnership

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Funding for this project has been provided by the Puget Sound Partnership

Summaries of these materials may be found on the Puget Sound Partnership's web page dedicated to low impact development.



ACKNOWLEDGEMENTS

LOCAL GOVERNMENT PARTICIPATING STAFF

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Samantha Trone	City of Port Townsend, Development Review Engineer, Public Works Department
Joe Irvin	City of Sequim, Associate Planner, Planning Department

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Special thanks to Foroozan Labib, Washington State Department of Ecology, and Curtis Hinman, Faculty of the Washington State University Pierce County Extension



LOW IMPACT DEVELOPMENT LOCAL REGULATION ASSISTANCE PROJECT 2009 PROJECT SUMMARY

INTRODUCTION

The purpose of this project was to provide technical assistance to local government staff for the preparation and/or revision of local codes and standards related to stormwater management and land development practices. The objective of this effort was to increase the use of the low impact development (LID) approach to stormwater management and LID practices for projects within the participating jurisdictions.

After completing three rounds of the LID Local Regulation Assistance Project in 2005-2008 (and assisting a total of 32 municipalities), the Puget Sound Partnership (PSP) staff facilitated a fourth round of LID technical assistance in 2009 for four additional local governments within the Puget Sound basin. A competitive application and interview process led the PSP to award LID technical assistance to the following four jurisdictions:

- City of Kent
- City of Port Townsend
- City of Sequim
- Island County

The primary goal for the project was to furnish specific recommendations to staff from the four local governments, and for the staff and managers at the four local governments to present the draft regulatory changes and LID recommendations for adoption by their local elected officials. Through adoption of the recommended code revisions, local governments would both remove regulatory obstacles inhibiting LID and facilitate the increased use of the LID approach and best management practices (BMPs) throughout the Puget Sound basin.

SCOPE OF SERVICES

To implement the project, staff from the PSP and AHBL designed the project to occur in each community with the following general steps:

- Initial Kickoff Meeting: PSP and AHBL staff met with local government staff from the four jurisdictions on January 13, 2009. This meeting, held at the offices of the Homebuilders Association of Kitsap County in Bremerton, introduced the project scope and timeline, and served to provide a shared understanding of LID principles and practices, and local political, economic, and environmental conditions that might influence the direction of the assistance. Local government staff were urged to form "teams" of staff from planning, public works and fire departments, and designate a local staff lead.
- Scope of Review: After the initial kickoff meeting, staff from each local government worked with AHBL staff to develop a draft scope of work. The first step in this process included local government staff first determining how they believed LID might be best implemented into the regulatory code, namely if LID would be encouraged, incentive based, prescriptive, or a combination of methods. Local government staff then identified regulations, specific code chapters, drainage standards, and road details that would need to be reviewed and revised. AHBL staff also identified new chapters that would be developed to fill gaps in the existing code and help each local government meet its objectives. AHBL and local government staff then scheduled two meeting dates.
- Policy Review Meeting (Meeting #1): At the policy review meeting (meeting #1), AHBL presented the findings of the initial regulatory review and provided each local government with preliminary recommendations and comments. Based on the findings of the policy review and meeting



discussion, the local government staff, PSP staff, and AHBL developed a final scope of services that AHBL would provide for each jurisdiction.

- **Draft Regulatory Materials:** The first policy review meeting provided AHBL with the scope of work and direction necessary to prepare draft regulatory materials, including amendments to existing local regulations, new ordinances, studies and additional information where requested. Depending on the structure of each jurisdiction's code, AHBL either amended existing chapters or sections to better facilitate LID, or developed new ordinances and standards to reflect the specific goals of the respective local government. These standards generally included amendments to storm water, zoning, subdivision, landscape, clear and grade, and planned unit development chapters. In addition, new road maintenance provisions, and published studies were provided to the participants.
- **Regulatory Amendments Meeting (Meeting #2):** At the regulatory amendments meeting (meeting #2), AHBL presented the draft regulatory materials and additional information as requested by the local government. Local government staff reviewed the documents and provided further input to AHBL staff.
- **Regulatory Language Final Draft:** After incorporating staff comments from each local government, and following review by PSP of all materials, and WSU Cooperative Extension Pierce County and the Department of Ecology for a representative sampling of draft materials, AHBL staff prepared final drafts of the regulations and standards. The final recommendations were in native and PDF files as well as in hard copy form.

COMMON THEMES AND LESSONS LEARNED

General:

The four participants in the 2009 Local Government Regulation Assistance Program consisted of three cities and one county. In general, jurisdictions were most commonly interested in LID standards and best management practices (BMPs) covering three topics or areas: stormwater regulations, clearing and grading, and tree conservation/native vegetation retention. Port Townsend, Sequim, and Island County generally sought assistance in how to implement LID in unique rural settings, where a large portion of development is infill or small-scale residential or commercial projects. The City of Kent, on the other hand, sought to make LID prescriptive in a rapidly expanding urban environment with a strong manufacturing and industrial base.

In past rounds of local technical assistance, jurisdictions were generally interested in promoting LID by providing incentives for "LID projects" through a new LID Draft Chapter. However, this round of technical assistance was different in that most jurisdictions chose to make LID prescriptive throughout the code. As such, AHBL's recommendations generally integrated LID BMPs throughout the code, particularly in the stormwater and drainage code chapters. AHBL increasingly found that some of the most common and effective LID BMPs were easiest to implement through the stormwater and drainage regulations. All four jurisdictions integrated new policies into their respective stormwater or drainage chapters which required a reduction in conventional stormwater volume through a combination of LID BMPs.

Another difference in this round of technical assistance was that all four jurisdictions requested policies to assess the potential for LID during the initial phases of project design. As such, AHBL developed policies and recommendations to make LID an integral part of development at the early stages of design, including LID site assessment procedures and LID pre-application consultations.

The recent Washington Court of Appeals ruling in *Citizens' Alliance for Property Rights v. Sims* on King County's native vegetation requirements in the County's Critical Areas Ordinance complicated this round of technical assistance. In that decision, the Court ruled that the County could not require 65% native vegetation retention in rural zones, as this requirement constitutes an unfair tax on property owners based on the court's interpretation of RCW 82.02.020. In the past, because retaining native vegetation



and minimizing impervious surfaces are such integral strategies of LID, AHBL has recommended that local governments set targets for minimum native vegetation retention and maximum impervious surface coverage based on land use and density. However, this court decision changed the course of AHBL's recommendations mid-stream. Instead of establishing specific requirements for native vegetation and impervious surface coverage, AHBL recommended that local governments set targets or requirements for reducing conventional stormwater volume through any combination of LID BMPs. In so doing, jurisdictions will still accomplish the same goals in facilitating LID while avoiding potential confrontation or land use challenges in light of the King County decision.

All of the consultant team's recommendations for this round of technical assistance were governed by the clause that LID techniques shall or should be implemented, 'unless proven infeasible, as determined by the Public Works Department.' As such, AHBL developed an outline of criteria (as an appendix) so that jurisdictions had an additional tool to help them determine when various LID BMPs were feasible on site as part of the development review process. The criteria were organized by BMP and include a simplified version of the standards found in the current edition of the *LID Technical Guidance Manual for Puget Sound* and Ecology's *Stormwater Management Manual for Puget Sound*.

AHBL provided recommendations for improving the existing code in light of the political climate in each jurisdiction. This resulted in suggestions for incremental improvements to the respective code, some of which were not entirely LID. Similar to previous rounds of technical assistance, most of the 2009 jurisdictions expressed appreciation that the deliverables consisted of "ready-for-adoption" ordinances and standards rather than more general forms of technical advice. Select code portions were amended in legislative underline/strikeout format to include additional or eliminate specific language or regulations.

Common Themes:

Project Scope

The scope of modifications and additions to the local government regulations generally included one or more of the following:

1. Zoning Code
 - a. Landscape requirements within existing codes.
 - b. Native vegetation recommendations where LID was required and native vegetation requirements in situations such as planned unit developments.
 - c. Requirements for pervious surfacing and integrating bioretention swales with required landscaping in parking areas where site and soil conditions make LID feasible.
2. Stormwater and Drainage Code
 - a. LID site assessment requirements were often integrated here or in the zoning code.
 - b. Conventional stormwater reduction goals/requirements through any combination of LID BMPs.
3. Clearing and Grading Chapter
 - a. Model language prepared by AHBL and DOE staff was either integrated into existing codes or accepted in its entirety.
 - b. The consultant team also developed an 'LID Construction Controls' document, which outlines standards to protect LID BMPs during construction.
4. Public Works Standards
 - a. Road standards allowing for more narrow driving lanes, reductions in impervious surface, alternative surfacing methods for shoulders and walkways, and bioretention facilities in roadside swales.
 - b. Stormwater management regulations allowing the recognition and application of the BMPs found in the *LID Technical Guidance Manual for Puget Sound* (January 2005 or as amended) and the *Stormwater Management Manual for Western Washington* (2005 or as amended).

Meetings and Document Review



PSP staff held a kickoff meeting on January 13, 2009 to introduce staff from the four local governments to the consultant team and to ensure that everyone began the project with a similar understanding of LID, project objectives and scope, timeline, process, and final products. Following the introductory meeting, two working meetings were held with teams of staff from each participating local government. The consultant team then prepared all final deliverables.

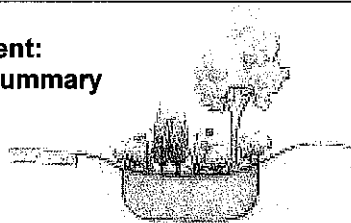
Meetings with participating jurisdictions included engineers, planners, natural resource staff, and the fire marshal. All of the jurisdictions kept a fairly consistent and diverse team of staff so that LID questions could be examined from different departmental perspectives.

One of the biggest differences in this round of technical assistance than in the past was that jurisdictions generally chose to make LID prescriptive in most or all areas of the code. The King County court decision also changed the how AHBL recommended implementation of LID in the code. Instead of setting up requirements for various LID BMPs based on land use, as was recommended in years past, the consultant team recommended that jurisdictions require a reduction in conventional stormwater volume through any combination of LID BMPs. This revised strategy helped local governments achieve their goals for integrating LID into the development process while still providing flexibility in site design.

Special thanks are in order to Ed O'Brien and Foroozan Labib of the Washington State Department of Ecology and Curtis Hinman of the Washington State University Pierce County Extension for reviewing draft documents developed under this project. The consultant team was impressed with the high level of effort and energy put forth by all staff members participating in this technical assistance project.



**City of Kent:
Project Summary**



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Scope of Assistance:

Prior to the policy review meeting on March 3, 2009, the City of Kent staff and AHBL staff agreed on a scope of services for the regulations to be reviewed. The following are the sections of the code that the City staff directed the consultant team to review:

- ◆ Title 7 – Utilities
- ◆ Title 11 – Environmental Management
- ◆ Title 12 – Planning and Land Development
- ◆ Title 13 – Fire Prevention and Protection
- ◆ Title 15 – Zoning
- ◆ Engineering Design and Construction Standards

This direction resulted in the review of the following Municipal Codes and standards by the consultant team:

- ◆ Title 7 – Utilities
 - 7.07 – Surface Water and Drainage Code
- ◆ Title 11 – Environmental Management
 - 11.04 – Shoreline Master Program
- ◆ Title 12 – Planning and Land Development
 - 12.05 – Mobile Home Parks
 - 12.06 – Recreational Vehicle Parks
- ◆ Title 15 – Zoning
 - 15.04 – District Regulations
 - 15.05 – Off-Street Parking and Loading Requirements
 - 15.07 – Landscaping Regulations
 - 15.08 – General and Supplementary Provisions
 - 15.09 – Administration
- ◆ Construction Standards: AHBL reviewed the proposed construction standard details and add LID language, detail drawings, and techniques where applicable.
- ◆ Additional Work Products:
 - Review the latest adopted Cottage Housing Ordinance for opportunities to incorporate LID.
 - Review Kent's Draft Subdivision Ordinance for opportunities to incorporate LID.

The policy review meeting with City of Kent staff occurred on March 3, 2009. At the meeting, City staff directed the consultant team on the content of the desired technical assistance. This direction resulted in the preparation of several work products to be reviewed by City staff with the consultant team at the regulatory amendments meeting on April 15, 2009. An outline of these work products is presented below in a topical manner with the full text of the updates attached separately.



Work Products:

1. Title 7 – Utilities - 7.07 – Surface Water and Drainage Code
AHBL incorporated new conventional stormwater volume reduction requirements into the code which are applicable to the whole City, unless proven infeasible as determined by the Public Works Department.
2. Title 11 – Environmental Management - 11.04 – Shoreline Master Program (SMP)
AHBL provided a few basic comments for integrating LID into the goals of the SMP.
3. Title 12 – Planning and Land Development - 12.05 – Mobile Home Parks
AHBL made minor revisions to this Chapter which included language promoting LID. However, Kent staff said that revisions to this Chapter were not a priority for adoption.
4. Title 12 – Planning and Land Development - 12.06 – Recreational Vehicle Parks
AHBL made minor revisions to this Chapter which included language promoting LID. However, Kent staff said that revisions to this Chapter were not a priority for adoption.
5. Title 15 – Zoning - 15.04 – District Regulations
The Kent Municipal Code already had existing impervious surface limits for many of the zones in the City, and AHBL provided additional recommendations for maximum impervious surface coverage where appropriate. Initially, the consultant team proposed minimum native vegetation retention standards in this Section, however in light of the Washington Court of Appeals decision on King County's code these recommendations were moved to the tree preservation requirements in 15.08 as encouraged standards.
6. Title 15 – Zoning - 15.05 – Off-Street Parking and Loading Requirements
Two provisions were recommended for this section, including a requirement for all parking spaces above the minimum required to be pervious unless infeasible as determined by Public Works and language facilitating the integration of parking lot landscaping with bioretention swales.
7. Title 15 – Zoning - 15.07 – Landscaping Regulations
AHBL made minor revisions to this Chapter, including the integration of required landscaping and bioretention swales where appropriate and feasible, and emphasizing the use of native species in landscaping.
8. Title 15 – Zoning - 15.08 – General and Supplementary Provisions
The consultant team provided native vegetation retention standards for sites based on land use and density. These standards include a definition of native vegetation and minimum tree density, minimum retention requirements, replanting requirements, soil amendment standards, and other general considerations.
9. Title 15 – Zoning - 15.09 – Administration
AHBL added some minor language calling for LID to be part of the criteria in development review and design review.
10. Cottage Housing Demonstration Project Ordinance
The principles behind cottage housing developments reinforce the goals of LID, as cottage housing developments aim to reduce building footprints and retain tracts of native vegetation. AHBL recommended that the demonstration projects be required to meet the new, proposed LID conventional volume reduction goals, and adhere to the standards in the draft Clearing and Grading Chapter.
11. Draft Clearing and Grading Chapter



Per the City's request, the consultant provided staff with a draft Clearing and Grading Code with a set of 'performance standards' from a model clear and grade chapter prepared by AHBL and approved by the Department of Ecology.

12. LID Road Standards and Details

AHBL provided road standards featuring LID components and the application of pervious surfaces.

Supplemental Information:

In addition, the consultant team provided the following:

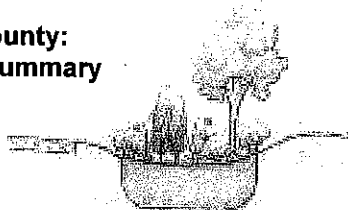
1. Tree species table listing Pacific Northwest native and near native species appropriate for native vegetation requirements, tree protection, and landscaping requirements.
2. "Draft Protection of LID IMPs During Construction" – A document prepared by AHBL that outlines construction sequencing and practices that protect pervious areas and LID BMPs during construction.
3. "Maintenance of LID Facilities" – Guidelines for the maintenance of pervious pavement, rain gardens and other LID management techniques.
4. "Criteria for Determining When LID is Feasible" – Outlines criteria to help local government staff determine when LID is feasible.
5. "Background of the LID Performance Standards" – Describes the background and general methodology behind the development of the conventional stormwater volume reduction standards, minimum native vegetation retention, and maximum impervious surface standards and modeling assumptions.
6. "Frequently Asked Questions About LID."

Findings:

A large portion of the City of Kent is located in a valley with a high ground water table and susceptible to flooding. As such, City staff had a keen interest in reducing surface water runoff and protecting local infrastructure through LID BMPs. Kent staff requested that recommendations make LID prescriptive throughout the City for most major development projects, by requiring conventional stormwater volume reduction through any combination of LID BMPs. This will be a key step in facilitating LID as the City continues to expand. In addition, the City was in need of detailed and LID focused clearing and grading standards, so the draft chapter provided by the consultant team will be a key tool in facilitating LID in the future.



**Island County:
Project Summary**



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Scope of Assistance:

Prior to the policy review meeting on February 26, 2009, Island County and AHBL staff agreed on a scope of services for the regulations to be reviewed. The following are the sections of the code that the County staff directed the consultant team to review:

- ◆ Title 11 – Land Development Standards
 - 11.01 – Land Development Standards
 - 11.02 – Clearing and Grading Requirements
 - 11.03 – Stormwater and Surface Water
- ◆ Title 16 – Planning and Subdivisions
 - 16.06 – Land Divisions and Dedications
 - 16.15 – Site Plan Review
 - 16.17 – Planned Residential Development
 - 16.19 – Land Use Review Process
- ◆ Title 17 – Zoning
 - 17.03.010 – 17.03.163 (Zones)
 - 17.03.180 – Land Use Standards
 - Engineering Design Standards
- ◆ Additional Work Products:
 - Review the existing Rural Stewardship Program and make recommendations for how can LID be implemented.

This direction resulted in the review of the following County Codes and standards by the consultant team:

- ◆ Title 11 – Land Development Standards
 - 11.01 – Land Development Standards
 - 11.02 – Clearing and Grading Requirements
 - 11.03 – Stormwater and Surface Water
- ◆ Title 16 – Planning and Subdivisions
 - 16.06 – Land Divisions and Dedications
 - 16.15 – Site Plan Review
 - 16.17 – Planned Residential Development
 - 16.19 – Land Use Review Process
- ◆ Title 17 – Zoning
 - 17.03.010 – 17.03.163 (Zones)
 - 17.03.180 – Land Use Standards
- ◆ Engineering Design Standards.
- ◆ Review the existing Rural Stewardship Program and make recommendations for how can LID be implemented.

The policy review meeting with Island County staff occurred on February 26, 2009. At the meeting, County staff directed the consultant team on the content of the desired technical assistance. This direction resulted in the preparation of several work products to be reviewed by County staff with the



consultant team at the regulatory amendments meeting on April 21, 2009. An outline of these work products is presented below in a topical manner with the full text of the updates attached separately.

Work Products:

1. 11.01 – Land Development Standards

County staff requested that the consultant team integrate LID into the goals and purpose of Title 11. Language was added to the “Purpose and Intent” of this Chapter to better facilitate LID. AHBL also recommended additional language that specifies a preference for the use of LID BMPs in road design where feasible.

2. 11.02 – Clearing and Grading Requirements

Per the County’s request, LID performance standards were added to this Chapter, and the County’s existing performance standards such as 11.02.330 – Erosion Control and 11.02.280 – Cuts or Excavations, were consolidated with the new performance standards. AHBL supplemented the existing definitions in this Chapter with new, applicable definitions based on the recommended performance standards.

Native vegetation retention standards were recommended as a new Section – 11.02.278 to this Chapter, and are encouraged for all development projects and preferred for PUD projects. These native vegetation standards were proposed as encouraged for all projects and preferred for PUDs, rather than required, in light of the Washington Court of Appeals decision on King County’s native vegetation requirements.

3. 11.03 – Stormwater and Surface Water

11.03.010 – Declaration of Purpose

Per the County’s request, the goals of LID were added to the purpose of this Section so that project applicants will better understand the reasoning behind the new LID standards. This addition coincides with the new amendments proposed in the ‘Purpose’ of 11.02.

11.03.092 – LID Site Analysis (New Section)

County staff agreed that the new proposed LID Site Analysis requirements (Section 11.03.092 – Low Impact Development Site Analysis), was a necessary addition to the Code in order to identify opportunities for LID in the early stages of project conception. The site analysis requires the applicant to document the site analysis with both textual and graphic information. The County will likely simplify some of these requirements after further review.

11.03.095 Low Impact Development Requirements (New Section)

This new Section makes the proposed LID standards in 11.03.220 a requirement for all major development activities, for development in public and capital improvement development projects, and development projects with 5,000 square feet of new impervious surface or clearing more than two acres.

11.03.105 – LID requirements for existing and new single-family residential lots under 10 acres (New Section)

The development of this new Section was particularly important to Island County staff, as there was no existing mechanism to require LID in smaller single-family residential lots. The new Section requires single-family residential development projects on new or existing lots less than 10 acres to manage any new impervious surface through any combination of LID BMPs. County staff felt this was a crucial addition to the code and necessary to achieve the County’s goals of recharging the community’s sole source aquifer.

11.03.220 – LID Requirements for Major Development Activity (New Section)

This new section requires LID to be used as the first option in stormwater management for all Major Development Activity, and public projects with 5,000 square feet of impervious surface or projects resulting in the clearing of two acres. County staff chose not to include specific LID



performance standards in this section, but rather to determine the amount of conventional volume reduction on a site-by-site basis.

4. Title 16 – Planning and Subdivisions

Recommended additions to this Title were relatively minor and include language integrating LID into the application requirements, application requirements for final approval, and criteria for final approval. The consultant team also recommended that an LID site analysis be a requirement for PRDs, so that LID can be incorporated into the site design to the early stages of project conception. Per the County's request, the consultant team also developed a new section, 16.19.075 - Low Impact Development (LID) Consultation, which requires a LID consultation for small residential development activities and for single-family residential lots where LID is required per 11.03.105.

5. Title 11 – Zoning

The recommendations to this title were minor and included new language under 17.03.075 – Rural Areas of More Intense Development (RAIDS), which references the LID requirements for RAIDS in Chapter 11.03.

6. Rural Stewardship Plan (RSP) Application

The consultant team provided recommendations on the County's existing RSP application which expanded the scope of LID techniques required by referencing the proposed requirements in Chapter 11.03 as well as BMP T5.13, the Department of Ecology's soil amendment standard. The other primary recommendations were to include references or guidelines for homeowners when choosing some of the various BMPs listed as options under this program.

7. LID Road Standards

AHBL provided two simple LID road sections for the County to add to the existing engineering design standards. The new road sections will serve as a foundation for variations on LID road design and construction.

Supplemental Information:

In addition, the consultant team provided the following:

1. Tree species table listing Pacific Northwest native and near native species appropriate for native vegetation requirements, tree protection, and landscaping requirements.
2. "Draft Protection of LID IMPs During Construction" – a document prepared by AHBL that outlines construction sequencing and practices that protect pervious areas and LID BMPs during construction.
3. "Maintenance of LID Facilities" – Guidelines for the maintenance of pervious pavement, rain gardens and other LID management techniques.
4. "Criteria for Determining When LID is Feasible" – Outlines criteria to help local government staff determine when LID is feasible.
5. "Background on the LID Performance Standards" – Describes the background and general methodology behind the development of the conventional stormwater volume reduction standards, minimum native vegetation retention, and maximum impervious surface standards and modeling assumptions.
6. "Frequently Asked Questions About LID."

Findings:

The biggest challenge for Island County staff during this process was deciding how LID would be implemented in the Code. In Island County, there is a heightened sense of urgency to expand the breadth and depth of LID in the County Code, as the community is dependent on a sole source aquifer and adequate groundwater for their primary potable water source. After much analysis and discussion, County staff decided to make LID prescriptive throughout the code and increase the level of site analysis and extent of LID BMP implementation based on the scale and type of project proposed. The new recommendations allowed Public Works staff to require more drainage analysis for small residential lots, larger development projects, and other types of projects that may not have required LID or any type of



drainage analysis under the existing Code. County staff recognized that the final recommendations will increase the amount of projects undergoing drainage review by Public Works and Planning, yet staff was committed to make LID work in order to preserve local resources and the community's livelihood.

**Port Townsend:
Project Summary**



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Scope of Assistance:

Prior to the policy review meeting on February 24, 2009, Port Townsend and AHBL staff agreed on a scope of services for the regulations to be reviewed. The following are the sections of the code that City staff directed the consultant team to review:

- ◆ Title 12 – Streets and Sidewalks
 - 12.04 – Transportation and Rights-of-Way Improvement Standards
 - 12.12 – Sidewalk Maintenance, Construction, and Repair
 - 12.24 – Street and Park Trees
- ◆ Title 13 – Water, Sewer, and Stormwater
 - 13.05 – Utility Rates and Charges
 - 13.31 – Utility Service-General Provisions
 - 13.32 – Stormwater Management Requirements
- ◆ Title 17 – Zoning
 - 17.32 – Planned Unit Developments (PUD)
 - 17.34 – Cottage Housing Development Design Standards
 - 17.36 – Multifamily Residential Development Standards
 - 17.44 – Commercial and Mixed Use Architectural and Site Design Standards
 - 17.46 – Commercial, Multifamily, Cottage Housing Developments, and Mixed Use Architectural and Site Design Review Processes
- ◆ Title 18 – Land Division
 - 18.24 – Subdivision and Development Standards
- ◆ Engineering Design Standards (EDS)
 - Chapter 4 – Stormwater
 - Chapter 6 – Transportation
 - Chapter 5 – Clearing, Grading, and Erosion Control
- ◆ Additional Work Products:
Port Townsend staff requested that AHBL prepare the following additional items:
 - A list of incentives that will facilitate the use of LID BMPs.
 - A list of street trees and plants that are appropriate for Port Townsend
 - Bioretention soil mix composition and field testing procedures.
 - A guidance manual for design, implementation, and maintenance of raingardens, bioretention swales, and other LID stormwater management techniques.
 - A new section in the EDS with warranty and maintenance provisions for plants and LID stormwater management facilities.
 - Resources for hydrologic modeling software that are user-friendly for the public.



Chapter 6 – Transportation

Per the City's request, the consultant team moved language from Chapter 12.12 – Sidewalk Maintenance, Construction, and Repair to this Chapter of the EDS. The addition was relatively minor and promoted the use of LID techniques, particularly permeable surfacing, where site and soil conditions make it feasible.

6. LID Road Standards
AHBL provided several LID road sections for the City to add to the existing engineering design standards. The new road sections will serve as a guide for LID road design and construction.
7. Additional Work Products:
AHBL prepared the following additional items:
 - A list of incentives that will facilitate the use of LID BMPs.
 - A document that outlines how edible landscapes relate to native vegetation and LID.
 - A user's guide to the LID performance standards table and modeling.

Supplemental Information:

In addition, the consultant team provided the following:

1. Tree species table listing Pacific Northwest native and near native species appropriate for native vegetation requirements, tree protection, and landscaping requirements.
2. "Draft Protection of LID IMPs During Construction" – a document prepared by AHBL that outlines construction sequencing and practices that protect pervious areas and LID BMPs during construction.
3. "Maintenance of LID Facilities" – Guidelines for the maintenance of pervious pavement, rain gardens and other LID management techniques.
4. "Criteria for Determining When LID is Feasible" – Outlines criteria to help local government staff determine when LID is feasible.
5. "Background on the LID Performance Standards" – Describes the background and general methodology behind the development of the conventional stormwater volume reduction standards, minimum native vegetation retention, and maximum impervious surface standards and modeling assumptions.
6. "Frequently Asked Questions About LID."

Findings:

Port Townsend staff chose to concentrate the majority of recommendations, including an LID site analysis and performance standards, in the Engineering and Design Standards. These new requirements were then referenced where applicable throughout the Code. For Port Townsend staff, like other jurisdictions participating in this round of the LID Local Government Regulation Assistance Project, the new LID performance standards and LID site analysis are critical components that will form the backbone for implementing LID BMPs throughout the City. The addition of new clearing and grading performance standards was also a valuable addition to the existing code, which is a critical component in carrying-out LID design and construction properly from start to finish. Port Townsend staff were committed to making LID standard practice in the City, while still maintaining site design flexibility and development efficiency for project applicants.



**Sequim:
Project Summary**



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Associate Planner
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Scope of Assistance:

Prior to the policy review meeting on February 24, 2009, Sequim and AHBL staff agreed on a scope of services for the regulations to be reviewed. The following are the sections of the code that City staff directed the consultant team to review:

- ◆ Title 12 – Streets, Sidewalks, and Public Places
- ◆ Title 13 – Public Services
 - 13.104 – Stormwater Management
 - 13.108 – Stormwater Maintenance
- ◆ Title 17 – Subdivisions
 - 17.12 – Administration and Enforcement
 - 17.20 – Subdivisions
 - 17.24 – Binding Site Plans
 - 17.28 – General Design Standards
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- ◆ Title 18 – Zoning
 - 18.22 – Development Standards
 - 18.24 – Design Standards
 - 18.40 - PUD
 - 18.44 – Bulk and Dimensional Requirements
 - 18.46 – Landscaping
 - 18.48 – Off-Street Parking

This direction resulted in the review of the following City Codes and standards by the consultant team:

- ◆ Title 12 – Streets, Sidewalks, and Public Places
- ◆ Title 13 – Public Services
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 - 18.44 – Bulk and Dimensional Requirements
 - 18.48 – Off-Street Parking
- ◆ Additional Work Products
Sequim staff requested that AHBL prepare the following additional items:



- Revise the existing tree retention standards in Chapter 18.28 and add native vegetation standards to reflect LID standards.
- Revise the existing Clear and Grade standards and/or provide a draft ordinance.
- Develop standards or criteria to determine when it is appropriate to retrofit existing conventional facilities with LID BMPs.
- Provide appropriate LID street sections or engineering standard drawings based on those referenced in Chapter 17.32.

The policy review meeting with City staff occurred on February 24, 2009. At the meeting, Sequim staff directed the consultant team on the content of the desired technical assistance. This direction resulted in the preparation of several work products to be reviewed by City staff with the consultant team at the regulatory amendments meeting on April 30, 2009. An outline of these work products is presented below in a topical manner with the full text of the updates attached separately. City made additional updates to the work products that were not necessarily LID-related.

Work Products:

1. Title 12 – Streets, Sidewalks, and Public Places

The majority of recommendations to this Title include new sections and language that facilitates permeable surfacing for sidewalks and right-of-ways, where site and soil conditions make LID feasible. A new section was added to encourage alternative street design that incorporates LID BMPs, particularly bioretention swales, where site and soil conditions make LID feasible.

2. Title 13 – Public Services

13.108 – Stormwater Maintenance

Revisions to this Chapter were minimal as the existing maintenance requirements already included the provisions necessary for adequately maintaining LID facilities.

3. Title 17 – Subdivisions

17.12 – Administration and Enforcement

The consultant team recommended that applicants conduct an LID site analysis and bring the results of this analysis to the required pre-application conference. City staff agreed that requiring more site analysis during the early stages of project conception was important. Several LID components were also added to the application procedures, including the LID site analysis findings, identification of significant trees and trees of local significance, and identification of proposed LID BMPs where applicable.

17.20 – Subdivisions

Recommended revisions to this Chapter were minor, and include language that makes the use of LID BMPs, when feasible, part of the review and approval criteria for subdivisions.

17.24 – Binding Site Plans

Recommended revisions to this Chapter were minor, and include language that makes the use of LID BMPs, when feasible, part of the review and approval criteria for binding site plans.

17.28 – General Design Standards

The consultant team recommended replacing the existing site analysis requirements for subdivisions with the LID site analysis requirements proposed in Section 18.22.015. Additional language was added that discusses native vegetation retention standards and facilitates the integration of required landscaping and bioretention swales, where feasible and appropriate based on site and soil conditions.

17.32 – Street Design Standards



Revisions to this Chapter include language that facilitates permeable surfacing for sidewalks and in rights-of-way where site and soil conditions make it feasible. Language facilitating shared driveways and alternative street design to accommodate various LID BMPs was added as well.

4. Title 18 – Zoning

18.22 – Development Standards

A new section was added to this Chapter, *18.22.015 – Site analysis required*, which requires an LID-focused site analysis for certain projects. Per the City's request, LID requirements were added to the Chapter that provides specific standards for the reduction of conventional stormwater volumes through a combination of LID BMPs. These proposed standards and the LID site analysis would provide a strong foundation for LID throughout Sequim's Code.

The City's existing Grading standards in this Chapter are minimal, and therefore the consultant team prepared a new draft Clearing and Grading Chapter – 18.23, at the request of City staff. A reference to the new draft Chapter was added to the existing Section.

Additional recommendations include revision of the existing tree standards and other minor additions to facilitate the use of LID BMPs in multifamily, commercial, mixed-use, and other uses.

18.23 – Land Clearing and Grading (new draft Chapter)

The draft Clearing and Grading Chapter, which was prepared by AHBL and approved by the Department of Ecology, provides LID-focused performance standards that include site containment, construction phasing, native vegetation retention and restoration, and more.

18.24 – Design Standards

Additions to this Chapter were fairly minor and include a plan to be submitted as part of the design review which shows any proposed LID BMPs. References to the *LID Technical Guidance Manual* were added as the preferred resource for design and construction of LID stormwater management facilities.

18.40 – PUD

Native vegetation retention standards were added to this Chapter as a preferred/encouraged standard, as the underlying goals and flexibility of PUD design.

18.44 – Bulk and Dimensional Requirements

The only recommendation made to this section was a reference to the LID standards proposed in 18.22.035.

18.48 – Off-Street Parking

This Chapter had existing LID language under Section 18.48.080 - Parking lot location, construction and design. AHBL modified the language slightly and added references to the LID engineering standard drawings that the consultant team prepared for the city. A provision was added to allow LID stormwater management facilities to be integrated with required landscaping where site and soil conditions permit.

5. LID Road Standards

AHBL provided several LID road sections for the City to add to the existing engineering design standards. The new road sections will serve as a guide for LID road design and construction.

Supplemental Information:

In addition, the consultant team provided the following:

1. Tree species table listing Pacific Northwest native and near native species appropriate for native vegetation requirements, tree protection, and landscaping requirements.
2. "Draft Protection of LID IMPs During Construction" – a document prepared by AHBL that outlines construction sequencing and practices that protect pervious areas and LID BMPs during construction.



3. "Maintenance of LID Facilities" – Guidelines for the maintenance of pervious pavement, rain gardens and other LID management techniques.
4. "Criteria for Determining When LID is Feasible" – Outlines criteria for to help local government staff determine when LID is feasible.
5. "Background on the LID Performance Standards" – Describes the background and general methodology behind the development of the conventional stormwater volume reduction standards, minimum native vegetation retention, and maximum impervious surface standards and modeling assumptions.
6. "Frequently Asked Questions About LID."

Findings:

Sequim staff commented that implementing LID best management practices had added importance in their community because the City has a drier climate and receives less rainfall on average than the rest of Puget Sound. Staff decided to make LID prescriptive throughout the code as a means to protect local resources, promote groundwater recharge, and provide irrigation opportunities for local agriculture. At the same time, Sequim staff were initially concerned about how effective LID could be in the City, since much of Sequim is characterized by a high groundwater table and clay soils. While these conditions can make some LID techniques difficult to implement, they do not preclude the use of LID. As such, the consultant team proposed all new code amendments with the clause that 'LID BMPs are required unless proven infeasible, as determined by the Public Works Department'.



LOW IMPACT DEVELOPMENT

LOCAL REGULATION ASSISTANCE PROJECT 2009

I. Technical Assistance and Recommendations

Kent, City of

Memos and Agendas

- a. Conference Call Agenda
- b. Scope of Assistance Memo
- c. Municipal Code Review Memo
- d. Meeting Agenda
- e. Meeting Summary Memo

Code Revisions

- a. Chapter 7.07 Surface Water and Drainage Code
- b. Chapter 12.05 Mobile Home Parks
- c. Chapter 12.06 Recreational Vehicle Park
- d. Chapter 15.04 District Regulations
- e. Chapter 15.05 Off-Street Parking and Loading Requirements
- f. Chapter 15.07 Landscaping Regulations
- g. Chapter 15.08 General and Supplementary Provisions
- h. Chapter 15.09 Administration
- i. Draft Chapter xx.xx Land Clearing and Grading
- j. Kent Cottage Housing Ordinance
- k. Kent Ordinance 3906 – Subdivision Code

LID Road Standards

- a. LID 6-4 (a): LID Typical Detail – Principal Arterial ROW
- b. LID 6-4 (b): LID Residential Street with Linear Detention Basin
- c. LID 6-4 (c): LID Typical Detail Community Boulevard
- d. LID 6-4 (d): LID Residential Street with Parking
- e. LID 6-4 (e): LID Typical Detail Road Section with Bike Lane
- f. LID 6-4 (f): LID Typical Detail Cul-de-sac Plan
- g. LID 6-4 (g): LID Typical Detail Cul-de-sac Plan
- h. LID 6-6 (c): LID Typical Detail Curb and Gutter Inlet
- i. LID 6-7 (a): LID Typical Pervious Paving
- j. LID 6-8 (b): LID Typical Detail Bioretention Swale

Island County

Memos and Agenda

- a. Scope of Assistance Memo
- b. Meeting Agenda
- c. Municipal Code Review Memo
- d. Draft Materials Memo
- e. Meeting Summary Memo

Code Revisions

- a. Chapter XVI Planning and Subdivision
 - i) Chapter 16.06 Land Divisions and Dedications
 - ii) Chapter 16.15 Site Plan Review
 - iii) Chapter 16.17 Planned Residential Development
 - iv) Chapter 16.19 Land Use Review Process
- b. Chapter XI Land Development Standards
- c. Chapter 17.03 island County Zoning Code
- d. Rural Stewardship Plan (RSP) Application
- e. Tree Species Table

LID Road Standards

- a. LID-01 LID Roadway Section - 60' ROW: Crowned Rural Road
- b. LID-02 LID Roadway Section - 60' ROW: Canted Rural Road
- c. LID-03 LID Typical Detail – Pervious Paving Section
- d. LID-04 LID Typical Detail – Bioretention Swale
- e. LID-05 LID Typical Detail – Optional: Curb Inlet Plan & Section

Port Townsend, City of

Memos and Agenda

- a. Meeting Agenda
- b. Scope of Assistance Memo
- c. Municipal Code Review Memo

Code Revisions

- a. Title 12 – Streets & Sidewalks
 - i) Chapter 12.04 – Transportation and Right Of Way Improvement Standards
- b. Title 13 – Water, Sewer & Stormwater
 - i) Chapter 13.05 - Utility, Rates & Charges
 - ii) Chapter 13.32 – Stormwater Management Requirements
- c. Title 17 – Zoning
 - i) Chapter 17.32 – Planned Unit Developments
 - ii) Chapter 17.34 – Cottage Housing Development Design Standards
 - iii) Chapter 17.36 – Multifamily Residential Development Standards
 - iv) Chapter 17.44 – Commercial and Mixed Use Architectural and Site Design Standards
 - v) Chapter 17.46 – Commercial, Multifamily, Cottage Housing Developments, and Mixed Use Architectural and Site Design Review Process
- d. Chapter 18.24 Subdivision Development Standards
- e. Engineering Standards
 - i) Chapter 4 – Stormwater
 - ii) Chapter 5 – Clearing, Grading and Erosion Control
 - iii) Chapter 6 – Transportation Engineering Design Standards
- f. Frequently Asked Questions about Native Vegetation and Edible Landscapes
- g. Port Townsend User's Guide to the LID Performance Standards Table

LID Road Standards

- a. LID-01 LID Road Section Arterial & Collector
- b. LID-02 Road Section Major Collector
- c. LID 03 Road Section Minor Collector
- d. LID 04 Typical Detail Bioretention Swale
- e. LID-05 Typical Detail Curb Inlet
- f. LID-06 Typical Detail Pervious Paving Details
- g. LID-07 Tree Box Detail Typical Section

- h. LID-08 Tree Box Detail Plan: Recessed Tree Box
- i. LID-09 Tree Box Detail Plan: Bulbed Tree Box

Sequim, City of

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Code Revisions

- a. Chapter 13.108 Stormwater Maintenance
- b. Chapter 17.12 Administration and Enforcement
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- d. Chapter 17.24 Binding Site Plans
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- j. Chapter 18.24 Design Standards Draft
- k. Chapter 18.40 Planned Unit Developments
- l. Chapter 18.44 Bulk and Dimensional Requirements
- m. Chapter 18.48 Off-Street Parking
- n. Title 12 – Streets, Sidewalks and Public Places

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- a. LID-01 LID Road Section Arterial Street
- b. LID-02 LID Road Section Minor Collector
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- e. LID-05 Parking Island Planting Swale
- f. LID-06 LID Standards Detail Bioretention Swale
- g. LID-07 Curb Inlet Detail Bioretention Swale
- h. LID-08 LID Alternative Surfacing Pervious Paving Details

II. Appendices

- a. Background on the LID Draft Chapter/LID Performance Standards Table
- b. Guidance for Determining When LID Should Not Be Required
- c. Ecoroof Questions and Answers (City of Portland)
- d. Frequently Asked Questions About LID
- e. Gravelpave2 Maintenance Guide (by Invisible Structures)
- f. Grasspave2 Maintenance Guide (by Invisible Structures)
- g. LID Best Management Practices (brochure in binder pocket)

- h. LID Economic Factsheet (WECO)**
- i. LID Info Packet (APA)**
- j. LID Incentives**
- k. Maintenance of Low Impact Development Facilities**
- l. Pervious Concrete (brochure in binder pocket)**
- m. Protection of LID IMPs During Construction**
- n. Reducing Stormwater Costs (EPA Full Report)**
- o. SEA Streets Cost Comparison Chart**
- p. SEA Streets Operation and Maintenance Cost Estimates**
- q. Stormwater Monitoring Two Ecoroofs in Portland, Oregon**
- r. Stormwater Utility User Fee Credits (Stormwater Journal article)**
- s. Standard Test Methods for Pervious Pavements**
- t. Tree Species (Recommended)**
- u. Vegetated Roof Cover Philadelphia, Pennsylvania (a Green Roof Study by the Environmental Protection Agency)**



LOW IMPACT DEVELOPMENT

LOCAL REGULATION ASSISTANCE PROJECT 2009

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**Sequim:
Project Summary**



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Work Products:

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The majority of recommendations to this Title include new sections and language that facilitates permeable surfacing for sidewalks and right-of-ways, where site and soil conditions make LID feasible. A new section was added to encourage alternative street design that incorporates LID BMPs, particularly bioretention swales, where site and soil conditions make LID feasible.

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Revisions to this Chapter were minimal as the existing maintenance requirements already included the provisions necessary for adequately maintaining LID facilities.

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The consultant team recommended that applicants conduct an LID site analysis and bring the results of this analysis to the required pre-application conference. City staff agreed that requiring more site analysis during the early stages of project conception was important. Several LID components were also added to the application procedures, including the LID site analysis findings, identification of significant trees and trees of local significance, and identification of proposed LID BMPs where applicable.

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Recommended revisions to this Chapter were minor, and include language that makes the use of LID BMPs, when feasible, part of the review and approval criteria for subdivisions.

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Native vegetation retention standards were added to this Chapter as a preferred/encouraged standard, as the underlying goals and flexibility of PUD design.

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The only recommendation made to this section was a reference to the LID standards proposed in 18.22.035.

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4. "Criteria for Determining When LID is Feasible" – Outlines criteria for to help local government staff determine when LID is feasible.
5. "Background on the LID Performance Standards" – Describes the background and general methodology behind the development of the conventional stormwater volume reduction standards, minimum native vegetation retention, and maximum impervious surface standards and modeling assumptions.
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Findings:

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Memo

TO: Joe Irvin, Associate Planner, Planning Department

FROM: Wayne E. Carlson, Brad Medrud, & Lisa Dulude

CC: Bruce Wulkan and John Cambalik (Puget Sound Partnership)

DATE: February 27, 2009

PROJECT: LID Technical Assistance

PROJECT #: 207700.31

SUBJECT: Municipal Code Review Memo

AHBL reviewed the portions of Sequim's Municipal Code that we discussed in our teleconference on January 27, 2009, to identify challenges to implementing low impact development (LID) best management practices (BMPs). This review helped us to gain a better understanding of how Sequim's Code functions and identify areas to integrate LID techniques. We intend to discuss these findings at our first meeting on March 5, 2009. Please note that these preliminary findings are intended to provide a starting point for discussion.

The areas of the Code that we reviewed are:

- ◆ Title 12 – Streets, Sidewalks, and Public Places
- ◆ Title 13 – Public Services
 - 13.104 – Stormwater Management
 - 13.108 – Stormwater Maintenance
- ◆ Title 17 – Subdivisions
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- 18.48 – Off-Street Parking
- ◆ Additional Work Products
Sequim staff has requested that AHBL prepare the following additional items:
 - Revise the existing tree retention standards in Chapter 18.28 and add native vegetation standards to reflect LID standards
 - Revise the existing Clear and Grade standards and/or provide a draft ordinance
 - Develop standards and criteria to determine when it is appropriate to retrofit existing conventional facilities to LID facilities
 - Provide appropriate LID street sections or engineering standard drawings based on those referenced in Chapter 17.32.

It is our understanding that portions of Sequim's Code already have language encouraging the use of LID BMPs. However, during our conference call City staff preferred that LID be integrated into the Code using a prescriptive approach. As such, we have made recommendations using prescriptive regulatory language. Below is a synopsis of our findings after reviewing each of the different areas of the Municipal Code and their relationship to LID.

1. Title 12 – Streets and Sidewalks

12.08 – Sidewalk Construction and 12.10 – Rights-of-Way

In both of these Chapters, we recommend adding provisions that facilitate the use of permeable surfacing and allowing for deviations from existing standards in order to accommodate projects that incorporate LID BMPs. Our recommendations make the use of LID BMPs in streets and sidewalks prescriptive unless site and soil conditions make LID infeasible, and require approval from the City.

2. Title 13 – Public Services

We have not included any proposed revisions for the two Chapters reviewed under this Title, as we would like to discuss our findings with the City at our first meeting before proposing changes.

13.104 - Stormwater Management

The City may wish to consider adding LID provisions to the "Purpose" section of this Chapter, which will establish LID as the first option for stormwater management unless site and soil conditions make the use of LID BMPs infeasible. A second topic for discussion is whether this Chapter is a more appropriate location for the LID standards proposed in Chapter 18.22, assuming the City decides to use some of the standards proposed.

13.108 - Stormwater Maintenance

The existing maintenance requirements include the provisions necessary for adequately maintaining LID facilities. We would like to discuss any concerns the City may have with maintenance of LID facilities under the current language.

3. Title 17 – Subdivisions

17.12 – Administration and Enforcement

Per the City's request, we have added an LID-focused site analysis as part of the application and submittal process for subdivisions. A reference to the proposed site analysis requirements, which are located in *18.22.015 – Site analysis required*, has been added as a requirement for the pre-application conference and application materials.

17.20 – Subdivisions

Revisions to this section were relatively minor and include provisions for LID under the elements to be considered during the project review, and a reference to the proposed LID site analysis in 18.22.015.

17.24 – Binding Site Plans

Recommendations for this Chapter were also minor and include a reference to the proposed LID site analysis in 18.22.015 as part of the design regulations for binding site plans.

17.28 – General Design Standards

During our conference call, the City requested that we integrate the existing site analysis requirements in this section with LID-focused site analysis standards. However, we anticipate that the City may want to apply these standards to other types of projects and therefore propose incorporating the site analysis standards as a new section under Title 18 – Zoning.

In addition, we have added language to Section 17.28.030 – Trees which aims to preserve mature trees with an 8-inch diameter or greater. We also recommend adding a new section, 17.28.035 – LID and Native Vegetation, which references the LID standards proposed in 18.22.035. The proposed LID standards set specific goals for the reduction of conventional stormwater pond volumes, the retention of native vegetation, and minimizing impervious surface coverage. Finally, we recommend adding provisions under the landscape section of this chapter which allow for LID stormwater management facilities to be integrated with required landscaping, provided that the purpose of the landscaping is not compromised and that site and soil conditions make LID feasible.

17.32 – Street Design Standards

The recommendations for this Chapter are similar to those made for Title 12 – Streets and Sidewalks, and include requirements for LID BMPs to be used whenever site and soil conditions permit. We have also added provisions for bioretention swales as an alternative to traditional stormwater management facilities, permitted deviations from sidewalk requirements in order to accommodate LID street design, and allowed permeable surfacing when feasible.

4. Title 18 – Zoning

18.22 – Development Standards

As discussed above in 17.28, we have added a new section to this Chapter, *18.22.015 – Site analysis required*, which requires an LID-focused site analysis for certain projects. During our first meeting, we would like to discuss with Sequim staff the types of projects that may require a site analysis.

During our conference call, the City requested that we develop standards or mechanics for implementing LID BMPs based on varying site conditions. As such, we have also proposed adding LID requirements to this Chapter which provide specific standards for the reduction of stormwater pond volumes, minimum native vegetation retention, and maximum impervious surface coverage. The City may choose to use some or all of these LID standards, and we would like to discuss how these standards will be integrated into the Code. We anticipate that these proposed standards and the LID site analysis will serve as the foundation for LID throughout Sequim's Code.

The existing Clear and Grade standards in this Chapter appear to be the primary standards, as we did not find additional Clear and Grade requirements in other areas of the Code. The City requested a new draft ordinance, and so we have provided a sample Clear and Grade Chapter for Sequim staff to review. We have added a new section to this Chapter that references the new draft Clear and Grade Draft Chapter 18.23 (provided as an attachment).

Additional recommendations for this Chapter include revision of the existing tree standards and other minor additions that to facilitate the use of LID BMPs.

18.24 – Design Standards

Additions to this Chapter were fairly minor and include a plan to be submitted as part of the design review which shows any proposed LID BMPs, and referencing the *LID Technical Guidance Manual* as the preferred resources for design and construction of LID stormwater management facilities.

18.40 – PUD

PUDs present a unique opportunity to incorporate LID as they are founded upon a flexible design process that aims to preserve and enhance the surrounding environment. As such, the City may want to consider making LID prescriptive in PUDs. We recommend adding LID to the Purpose of this Chapter so that LID is more of an integral component of PUD design. We have also added references to the proposed LID site analysis in 18.22.015, as well as the LID standards proposed in Section 18.22.035.

We recommend adding specific LID elements to be included on the plan as part of the application requirements. This can either be incorporated in a generally through the few points that we have added, or the City may want to require that the proposed site analysis requirements be submitted as part of the application.

18.44 – Bulk and Dimensional Requirements

The only recommendation made to this section is a reference to the LID standards proposed in 18.22.035.

18.46 – Landscaping (Draft Ordinance in PDF format)

We did not find too much LID pertinent material in the Interim Landscaping Ordinance, however there is the potential to put the proposed native vegetation requirements in this Chapter rather than in 18.22.035.

18.48 – Off-Street Parking

This Chapter already contains language under Section 18.48.080 - Parking lot location, construction and design. We have modified the language slightly and added references to the LID engineering standard drawings which we will be developing for the City. We have also added a provision allowing for LID stormwater management facilities to be integrated with required landscaping where site and soil conditions permit.

5. Additional Work Products

- *Revise the existing tree retention standards in Chapter 18.22 and add native vegetation standards to reflect LID standard.*
We have started working on this as is discussed elsewhere in this memorandum.
- *Revise the existing Clear and Grade standards and/or provide a draft ordinance.*

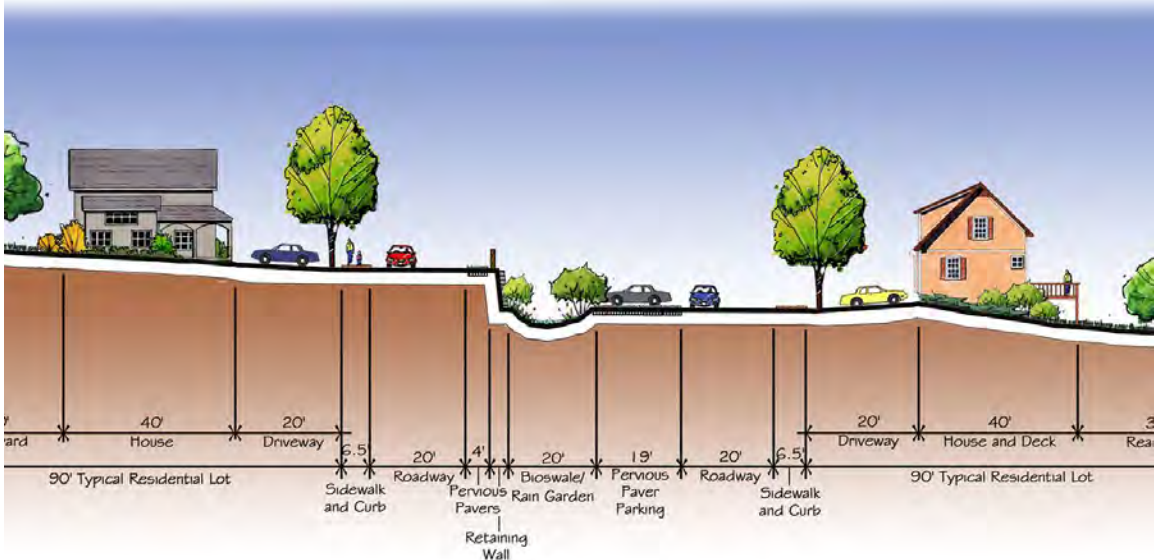
Please see the sample Clear and Grade Chapter.

- *Develop standards and criteria to determine when it is appropriate to retrofit existing conventional facilities to LID facilities.*

We will provide this for review at the second meeting.

- *Provide appropriate LID street sections or engineering standard drawings.*

We will provide these for review at the second meeting.



**City of Sequim
Low Impact Development (LID)
Regulatory Assistance
First Meeting**

**March 5, 2009
9:00AM – 11:00AM**

-
- | | |
|---------|--|
| 9:00 am | A. Introductions |
| 9:10 am | B. Summarize Request – Scope of Assistance |
| 9:20 am | C. Code Review Discussion: <ol style="list-style-type: none"> 1. Title 12 – Streets, Sidewalks, and Public Places 2. Title 13 – Public Services <ol style="list-style-type: none"> a. 13.104 – Stormwater Management b. 13.108 – Stormwater Maintenance 3. Title 17 – Subdivisions <ol style="list-style-type: none"> a. 17.12 – Administration and Enforcement b. 17.20 – Subdivisions c. 17.24 – Binding Site Plans d. 17.28 – General Design Standards e. 17.32 – Street Design Standards 4. Title 18 – Zoning <ol style="list-style-type: none"> a. 18.22 – Development Standards b. 18.23 – Draft Clear and Grade Chapter c. 18.24 – Design Standards d. 18.40 – PUD e. 18.44 – Bulk and Dimensional Requirements f. 18.46 – Landscaping g. 18.48 – Off-Street Parking 5. Additional Work Products - Sequim staff has requested that AHBL prepare the following additional items: |

- a. Revise the existing tree retention standards in Chapter 17.28 and add native vegetation standards to reflect LID standards
- b. Revise the existing Clear and Grade standards and/or provide a draft ordinance
- c. Develop standards and criteria to determine when it is appropriate to retrofit existing conventional facilities to LID facilities
- d. Provide appropriate LID street sections or engineering standard drawings based on those referenced in Chapter 17.32.

10:50 am D. Next Steps and Schedule

Memo

To: City of Sequim
Joseph Irvin, Associate Planner
Planning Department
152 West Cedar Street
Sequim, WA 98382

From: Brad Medrud, Lisa Dulude, and Wayne Carlson

CC: Bruce Wulkan and John Cambalik, Puget Sound Partnership

Our File No.: 207700.31

Date: January 30, 2009

Re: Low Impact Development Technical Assistance Scope of Work

Scope of Assistance:

During the conference call on January 27, 2009, City of Sequim staff and AHBL staff developed a scope of services for the Low Impact Development (LID) Technical Assistance Project. Sequim staff has requested the consultant team review the following areas of the Municipal Code:

- ◆ Title 12 – Streets, Sidewalks, and Public Places
- ◆ Title 13 – Public Services
 - 13.104 – Stormwater Management
 - 13.108 – Stormwater Maintenance
- ◆ Title 17 – Subdivisions
 - 17.12 – Administration and Enforcement
 - 17.20 – Subdivisions
 - 17.24 – Binding Site Plans
 - 17.28 – General Design Standards
 - 17.32 – Street Design Standards
- ◆ Title 18 – Zoning
 - 18.22 – Development Standards
 - 18.24 – Design Standards
 - 18.40 - PUD
 - 18.44 – Bulk and Dimensional Requirements
 - 18.46 – Landscaping
 - 18.48 – Off-Street Parking



◆ Additional Work Products

Sequim staff has requested that AHBL prepare the following additional items:

- Revise the existing tree retention standards in Chapter 17.28 and add native vegetation standards to reflect LID standards
- Revise the existing Clear and Grade standards and/or provide a draft ordinance
- Develop standards and criteria to determine when it is appropriate to retrofit existing conventional facilities to LID facilities
- Provide appropriate LID street sections or engineering standard drawings based on those referenced in Chapter 17.32.

The consultant team will meet with Sequim staff (dates TBD) for two in-person meetings. The purpose of the first meeting will be to review the codes and standards specified above and identify gaps in the existing codes that would pose impediments to the implementation of LID. During the second meeting, AHBL will present drafts of the revised codes and standards for City staff review.

If you have any questions or concerns regarding the above scope of assistance, please do not hesitate to contact us. Our telephone number is (253) 383-2422 and our respective e-mail addresses are:

Brad Medrud – bmedrud@ahbl.com

Lisa Dulude – ldulude@ahbl.com

Wayne Carlson – wecarlson@ahbl.com

Thank you and we look forward to working with you in the months ahead.

Chapter 13.108
STORMWATER MAINTENANCE

Sections:

Article I. Findings of Fact, Need and Purpose

- 13.108.010 Findings of fact.**
- 13.108.020 Need.**
- 13.108.030 Purpose.**

Article II. Definitions

- 13.108.040 Application.**

Article III. General Provisions

- 13.108.050 Abrogation and greater restrictions.**
- 13.108.060 Interpretation.**

Article IV. Applicability

- 13.108.070 Conflict.**

Article V. General Requirements

- 13.108.080 Maintenance required.**
- 13.108.090 Minimum standards.**
- 13.108.100 Disposal of waste from maintenance activities.**
- 13.108.110 Compliance.**

Article VI. Administration

- 13.108.120 Director.**
- 13.108.130 Inspection authority.**
- 13.108.140 Enforcement authority.**

Article VII. Inspection Program

- 13.108.150 Inspection.**
- 13.108.160 Procedures.**
- 13.108.170 Inspection schedule.**
- 13.108.180 Inspection and maintenance records.**
- 13.108.190 Reporting requirements.**

Article VIII. Enforcement

- 13.108.200 General.**
- 13.108.210 Orders.**
- 13.108.220 Civil penalty.**
- 13.108.230 Penalties due.**
- 13.108.240 Penalties recovered.**

Article I. Findings of Fact, Need and Purpose

13.108.010 Findings of fact.

City council of the city hereby finds that:

- A. Stormwater facilities are a common feature of urban development.
- B. In order to function properly so that they will perform as designed to prevent or remove pollution and/or to reduce flooding, stormwater facilities must be regularly inspected and maintained.

- C. If not adequately maintained, stormwater facilities can become sources of pollutants to surface water and ground water.
- D. If not adequately maintained, stormwater facilities could fail and cause considerable damage to the public. (Ord. 95-004 § 1.1)

13.108.020 Need.

The city council finds that this chapter is necessary in order to ensure maintenance of all stormwater facilities within the city by setting minimum standards for the inspection and maintenance of stormwater facilities. (Ord. 95-004 § 1.2)

13.108.030 Purpose.

The provisions of this chapter are intended to:

- A. Provide for inspection and maintenance of stormwater facilities in the city to provide for an effective, functional stormwater drainage system.
- B. Authorize the public works director to require that stormwater facilities be operated, maintained and repaired in conformance with this chapter.
- C. Establish the minimum level of compliance that must be met.
- D. Guide and advise all who conduct inspection and maintenance of stormwater facilities. (Ord. 95-004 § 1.3)

Article II. Definitions

13.108.040 Application.

For the purposes of this chapter, the following definitions shall apply:

- A. "Best management practice" or "BMP" means physical, structural, and/or managerial practices that, when used singly or in combination, prevent or reduce pollution of water. BMPs are listed and described in the manual.
- B. "Person" means any individual, partnership, corporation, association, organization, cooperative, public or municipal corporation, agency of the state, or local government unit, however designated.
- C. "Stormwater" means that portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, channels or pipes into a defined surface water channel, or a constructed infiltration facility.
- D. "Stormwater drainage system" means constructed and natural features that function together as a system to collect, convey, channel, hold, inhibit, retain, detain, infiltrate, divert, treat or filter stormwater.
- E. "Stormwater facility" means a constructed component of a stormwater drainage system, designed or constructed to perform a particular function, or multiple functions. Stormwater facilities include, but are not limited to, pipes, swales, ditches, culverts, street gutters, detention basins, retention basins, constructed wetlands, infiltration devices, catchbasins, oil/water separators, sediment basins and modular pavement. Stormwater facilities are described in the manual.
- F. "Stormwater Management Manual" or "manual" means the Stormwater Management Manual for the Puget Sound Basin, adopted by reference and prepared by Ecology that contains BMPs to prevent or reduce pollution. The Stormwater Management Manual contains BMPs to prevent or reduce pollution and maintenance provisions for all BMPs. (Ord. 95-004 § 2)

Article III. General Provisions

13.108.050 Abrogation and greater restrictions.

It is not intended that this chapter repeal, abrogate, or impair any existing regulations, easements, covenants, or deed restrictions. However, where this chapter imposes greater restrictions, the provisions of this chapter shall prevail. (Ord. 95-004 § 3.1)

13.108.060 Interpretation.

The provisions of this chapter shall be held to be minimum requirements in their interpretation and application and shall be liberally construed to serve the purposes of this chapter. (Ord. 95-004 § 3.2)

Article IV. Applicability

13.108.070 Conflict.

When any provision of any other ordinance of the city conflicts with this chapter, that which provides more environmental protection shall apply unless specifically provided otherwise in this chapter. (Ord. 95-004 § 4)

Article V. General Requirements

13.108.080 Maintenance required.

All stormwater facilities shall be maintained in accordance with this chapter and the Stormwater Management Manual. Systematic, routine preventive maintenance is preferred. (Ord. 95-004 § 5.1)

13.108.090 Minimum standards.

The following are the minimum standards for the maintenance of stormwater facilities:

A. Facilities shall be inspected annually and cleared of debris, sediment and vegetation when they affect the functioning and/or design capacity of the facility.

B. Grassy swales and other bioretention swales shall be inspected monthly and mowed or replanted as necessary. Clippings are to be removed and properly disposed of. Low impact development (LID) stormwater management facilities, such as bioretention swales and raingardens, shall be maintained in accordance with the guidelines in the *Maintenance of LID Facilities Manual* (current edition).

C. Where lack of maintenance is causing or contributing to a water quality problem, immediate action shall be taken to correct the problem. Within one month, the director shall revisit the facility to assure that it is being maintained. (Ord. 95-004 § 5.2)

13.108.100 Disposal of waste from maintenance activities.

Disposal of waste from maintenance activities shall be conducted in accordance with the minimum Functional Standards for Solid Waste Handling, Chapter 173-304 WAC, guidelines for disposal of waste materials from stormwater maintenance activities, and where appropriate, the Dangerous Waste Regulations, Chapter 173-303 WAC. (Ord. 95-004 § 5.3)

13.108.110 Compliance.

Property owners are responsible for the maintenance, operation or repair of stormwater drainage systems and BMPs. Property owners shall maintain, operate and repair these facilities in compliance with the requirements of this chapter and the Stormwater Management Manual. (Ord. 95-004 § 5.4)

Article VI. Administration

13.108.120 Director.

The public works director or a designee/inspector shall administer this chapter and shall be referred to as the director. (Ord. 95-004 § 6.1)

13.108.130 Inspection authority.

The director is directed and authorized to develop an inspection program for stormwater facilities in the city. (Ord. 95-004 § 6.2)

13.108.140 Enforcement authority.

The director shall have the authority to develop and implement administrative procedures to administer and enforce this chapter. (Ord. 95-004 § 6.3)

Article VII. Inspection Program

13.108.150 Inspection.

Whenever implementing the provisions of the inspection program or whenever there is cause to believe that a violation of this chapter has been or is being committed, the inspector is authorized to inspect, during regular working hours and at other reasonable times, all stormwater drainage systems, including LID stormwater management facilities, within the city to determine compliance with the provisions of this chapter. (Ord. 95-004 § 7.1)

13.108.160 Procedures.

Prior to making any inspections, the inspector shall present identification credentials, state the reason for the inspection, and request entry.

A. If the property, or any building or structure on the property, is unoccupied, the inspector shall first make a reasonable effort to locate the owner or other person(s) having charge or control of the property or portions of the property and request entry.

B. If after reasonable effort, the inspector is unable to locate the owner or other person(s) having charge or control of the property, and has reason to believe the condition of the stormwater drainage system creates an imminent hazard to persons or property, the inspector may enter.

C. Unless entry is consented to by the owner or person(s) in control of the property or portion of the property, or unless conditions are reasonably believed to exist that create imminent hazard, the inspector shall obtain a search warrant prior to entry, as authorized by the laws of the state of Washington.

D. The inspector may inspect the stormwater drainage system without obtaining a search warrant provided for in subsection C above; provided the inspection can be conducted while remaining on the public property or other property on which permission to enter is obtained. (Ord. 95-004 § 7.2)

13.108.170 Inspection schedule.

The director shall establish a master inspection and maintenance schedule to inspect appropriate stormwater facilities that are not owned by the city. Inspections shall be annual for facilities constructed under provisions of the manual. Inspection of existing facilities shall be annual upon the city adopting a stormwater utility that funds an inspection program. Critical stormwater facilities and LID stormwater management facilities may require a more frequent inspection schedule. (Ord. 95-004 § 7.3)

13.108.180 Inspection and maintenance records.

As existing stormwater facilities are encountered, they shall be added to the master inspection and maintenance schedule. Records of new stormwater facilities shall include the following:

A. As-built plans and locations.

B. Findings of fact from any exemption granted by the local government.

C. Operation and maintenance requirements and records of inspections, maintenance actions and frequencies.

D. Engineering reports, as appropriate. (Ord. 95-004 § 7.4)

13.108.190 Reporting requirements.

The director shall report annually to the city council about the status of the inspections. The annual report may include, but need not be limited to, the proportion of the components found in and out of compliance, the need to upgrade components, enforcement actions taken, compliance with the inspection schedule, the resources needed to comply with the schedule, and comparisons with previous years. (Ord. 95-004 § 7.5)

Article VIII. Enforcement

13.108.200 General.

Enforcement action shall be taken whenever a person has violated any provision of this chapter. The choice of enforcement action taken and the severity of any penalty shall be based on the nature of the violation, the damage or risk to the public or to public resources, and/or the degree of bad faith of the persons subject to the enforcement action. (Ord. 95-004 § 8.1)

13.108.210 Orders.

The director shall have the authority to issue to an owner or person an order to maintain or repair a component of a stormwater facility or BMP to bring it in compliance with this chapter, the Stormwater Management Manual and/or city regulations. The order shall include:

- A. A description of the specific nature, extent and time of the violation and the damage or potential damage that reasonably might occur;
- B. A notice that the violation, or the potential violation, cease and desist and, in appropriate cases, the specific corrective actions to be taken; and
- C. A reasonable time to comply, depending on the circumstances. (Ord. 95-004 § 8.2)

13.108.220 Civil penalty.

A person who fails to comply with the requirements of this chapter or who fails to conform to the terms of an approval or order issued shall be subject to a civil penalty.

- A. Amount of Penalty. The penalty shall be \$100.00 for each violation. Each day of continued violation or repeated violation shall constitute a separate violation.
- B. Aiding or Abetting. Any person who, through an act of commission or omission, aids or abets in the violation shall be considered to have committed a violation for the purposes of the civil penalty.
- C. Notice of Penalty. A civil penalty shall be imposed by a notice in writing, either by certified mail with return receipt requested or by personal service, to the person incurring the same from the city. The notice shall describe the violation, the date(s) of violation, and shall order the acts constituting the violation to cease and desist and, in appropriate cases, require necessary corrective action within a specific time.
- D. Application for Remission or Mitigation. Any person incurring a penalty may apply in writing within 10 days of receipt of the penalty to the city for remission or mitigation of such penalty. Upon receipt of the application, the city council may remit or mitigate the penalty only upon a demonstration of extraordinary circumstances, such as the presence of information or factors not considered in setting the original penalty.
- E. Appeal of City Penalty. Persons incurring a penalty imposed by the director may appeal in writing within 10 days of the receipt of the penalty to the city council. The city council's decision may be appealed to the Supreme Court within 10 days of the decision. (Ord. 95-004 § 8.3)

13.108.230 Penalties due.

Penalties imposed under this section shall become due and payable 30 days after receiving notice of penalty, unless application for remission or mitigation is made or an appeal is filed. Whenever an application for remission or mitigation is made, penalties shall become due and payable 30 days after receipt of the decision regarding the remission or mitigation. Whenever an appeal of a penalty is filed, the penalty shall become due and payable after all review proceedings and a final decision has been issued confirming all or part of the penalty. If the amount of a penalty owed is not paid within the time specified in this section, the city may take actions necessary to recover such penalty. (Ord. 95-004 § 8.4)

13.108.240 Penalties recovered.

Penalties recovered shall be paid to a fund dedicated to enforcement and/or enhancement of the stormwater management program. (Ord. 95-004 § 8.5)

Chapter 17.12
ADMINISTRATION AND ENFORCEMENT

Sections:

- 17.12.010 Administration.**
- 17.12.015 Preapplication conference required.**
- 17.12.020 Procedure – Application.**
- 17.12.030 Procedure – Fees.**
- 17.12.040 Procedure – Determination of completeness – Distribution of applications.**
- 17.12.050 Procedure – Notice of hearing.**
- 17.12.060 Development of illegally divided land.**
- 17.12.070 Penalties for violation.**
- 17.12.080 Optional code election.**

17.12.010 Administration.

The planning department shall administer the subdivision and platting regulations of this title. The planning department may prepare and require the use of such forms as are essential to such administration. The planning department, where applicable, shall review all proposed subdivisions for the purpose of determining conformance with state law, the general purposes of the comprehensive plan, and the design standards and engineering specifications found in this title. Final authority to approve plats and subdivisions resides with the planning director and/or city council, as applicable. Notwithstanding this precept, it is the intent that the planning director has the authority to make advisory determinations in accordance with the provisions of this title. (Ord. 2007-014 § 1; Ord. 98-005 § 4)

17.12.015 Preapplication conference required.

Preapplication conference shall be required for all applications for subdivision, binding site plan and boundary line adjustment approval consistent with the provisions of SMC Title 20, unless preapplication is specifically exempted by the planning director. The following information shall be submitted with the request for a preapplication conference:

A. A completed preapplication form as provided by the city;

B. A conceptual site analysis consistent with the requirements of Section 18.22.015, including opportunities to use low impact development (LID) best management practices (BMPs) where site and soil conditions make LID feasible, as determined by the City Engineer. All LID BMPs shall be designed and constructed in accordance with the LID Technical Guidance Manual for Puget Sound (current edition). The site analysis shall be required as part of the preliminary plat application materials in order for the project to be vested

C. A preliminary sketch or conceptual design which includes proposed lot configurations, utilities, streets and rights-of-way, open spaces, and existing structures, improvements, and approximate location of any critical areas, irrigation or drainage ditches and other significant natural features;

D. A vicinity map and tax assessor's parcel map, with the location of the subject property clearly marked. (Ord. 2007-014 § 1; Ord. 98-005 § 4)

17.12.020 Procedure – Application.

An application for subdivision, [binding site plan](#), or subdivision exemption, as defined by SMC 17.04.020, shall include as applicable, the items specified in Table 17.12.020(A).

Table 17.12.020(A)

Application Type	Boundary Line Adjustment (BLAs)	Minor Subdivisions	Major Subdivisions	Binding Site Plans Major and Minor
<u>Required Submittal Items</u>				
<u>Required Submittal Item</u>				
Preapplication meeting	X¹	X¹	X	X¹
Field survey by a licensed land surveyor.	<u>X</u>	<u>X</u>	<u>X</u>	<u>X</u>
Site analysis graphics and textual information as per SMC 18.22.015	<u>X</u>	<u>X</u>	<u>X</u>	<u>X</u>
Preapplication checklist (provided by the city of Sequim) and a preliminary sketch or conceptual design as per SMC 17.12.015, and a vicinity map and tax assessor's parcel map, with the location of the subject property clearly marked		X¹	X	X¹
Subdivision or plan name		X	X	X
Completed application form	X	X	X	X
Legal description (township, section and range, tax parcel number)	X	X	X	X
Preliminary sketch (drawn at 1" = 100')	X	X	X	X
North arrow	X	X	X	X
Bar scale	X	X	X	X
Acreage of proposed lots or tracts	X	X	X	X
Dimensions of proposed lots or structures	X	X	X	X
Size and location of existing structures	X	X	X	X
Size and location of existing and proposed streets, alleys and rights-of-way, including proposed ownership	X	X	X	X
Proposed open spaces or public or private dedications for lands, trails, parks or passive and active recreation		X	X	X
Location of streams, irrigation ditches, drainage ditches,	X	X	X	X

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wetlands, ponds, floodways or other water courses on or within 200' of the proposed project				
Location, extent and type of wooded areas and all trees greater than eight inches in diameter, or identified as species of local significance. All trees eight inches in diameter and greater shall be noted on the site plan.	X	X	X	X
All species of local significance shall be noted on the site plan.	X	X	X	X
Location and size of proposed LID BMPs (if applicable) and in conformance with 17.28.020 and 18.22.015 of the SMC.	X	X	X	X
Location and extent of existing and proposed landscaping		X	X	X
Location and extent of steep slopes (more than 15%) and other significant physical features	X	X	X	X
Proposed and existing easements for ingress, egress, utility corridors, irrigation ditch access, and other easements	X	X	X	X
Adjacent property owners' list for all properties located within a 300' radius obtained from the Clallam County assessor's office		X	X	X
Two separate illustrations or plan maps or diagrams, drawn to a common scale, depicting the "before" and "after" conditions of the proposed adjustment	X			
A title report, subdivision certificate, or other proof of ownership which documents any previous land use approvals		X	X	X
A scaled vicinity map showing the subject property in reference to surrounding properties, streets, subdivisions, municipal boundaries, identified critical areas within 500' of the subject property, and including a north arrow		X	X	X

Sequim Municipal Code

Copies of any existing and/or proposed deed restrictions or covenants	X	X	X	X
Draft maintenance agreements and proposed management entities responsible for tax payments and maintenance of common facilities (such as roads, stormwater facilities, open spaces, trails, parks, etc.)		X	X	X
Preliminary phasing plan, if proposed <u>in conformance with 17.26 of the SMC</u>			X	X
Preliminary stormwater drainage plans, prepared consistent with the requirements of SMC Title 13 <u>and SMC Section 18.22.0125 (if applicable)</u> .		X	X	X
Preliminary utility plans, including provisions for water, sewer, <u>reclaimed water</u> , <u>stormwater</u> and underground power where appropriate, telecommunications, and solid waste disposal		X	X	X
Preliminary road plans including plan, sections, and profiles		X²	X	X
Preliminary clearing and grading plans, including cut and fill amounts		X	X	X
Environmental information worksheet and SEPA checklist		X³	X	X³
Preliminary landscaping plans			X	X
A description of how parking requirements will be met			X	X
Any additional materials, as determined by the department during the required preapplication meeting, to be necessary to fully evaluate the application	X	X	X	X
For proposed replatting of existing subdivisions: the lots, blocks, streets, etc. of the original plat shown with dotted lines in the proper positions in relation to the new arrangement of the plat, the new plat being		X	X	X

clearly shown in solid lines to avoid ambiguity				
Number of copies required of application materials to be submitted	53	35	35	53
Number of copies of any plats, plans or maps greater than 11" x 17"	305	305	305	530
Notes	<p>1. Pre-application Pre-application conference may be waived by permission of the the planning director.</p> <p>2. Sections and profiles may not be required for minor subdivisions, with permission of the planning director.</p> <p>3. Minor subdivisions of nine or fewer lots and minor binding site plans may be exempt from SEPA, consistent with the requirements of SMC Title 16 and WAC 197-11-800.</p>			

(Ord. 2007-014 § 1; Ord. 98-005 § 4)

17.12.030 Procedure – Fees.

Application fees shall be paid consistent with Chapter 20.05 SMC, Fee Schedule. (Ord. 2007-014 § 1; Ord. 98-005 § 4)

17.12.040 Procedure – Determination of completeness – Distribution of applications.

If in the opinion of the planning director or his/her designee, the application is deemed complete, consistent with requirements of SMC Title 20, a copy of the application shall be forwarded to the appropriate agencies and officials, and the application shall be noticed consistent with the requirements of SMC Title 20, Land Use and Development. (Ord. 2007-014 § 1; Ord. 98-005 § 4)

17.12.050 Procedure – Notice of hearing.

When required, the planning department shall provide notice of a public hearing consistent with the requirements of SMC Title 20, Land Use and Development. (Ord. 2007-014 § 1; Ord. 98-005 § 4)

17.12.060 Development of illegally divided land.

An application for a building permit, septic tank installation or other development permit for any lot, tract or parcel of land divided in violation of state law or this title shall not be granted without prior approval of the city council, consistent with the provisions of Chapter 58.17 RCW. (Ord. 2007-014 § 1; Ord. 98-005 § 4)

17.12.070 Penalties for violation.

A. In the event subdivision occurs in violation of the provisions of this title, the city shall have the authority to enjoin any transfer, sale, agreement, lease or option concerning the property involved; or to bring an appropriate action for damages, abatement, specific performance or any other remedy allowed by law; provided, that the failure of the city to so enjoin any transfer, etc., shall not prejudice the city's other rights under this title.

B. The costs of such action shall be assessed against the person, firm, corporation or agent selling or transferring the property, including reasonable attorneys' fees.

C. Any person, agent, firm or developer who violates any provision of this title shall be guilty of a misdemeanor and upon conviction may be subject to a fine not to exceed \$500.00

(U.S. funds) or imprisonment for a period not to exceed 30 days, or both such fine and imprisonment; and each sale, offer for sale, lease or transfer of each separate lot, tract or parcel of land in violation of any provision of this title shall be deemed a separate and distinct offense. (Ord. 2007-014 § 1; Ord. 98-005 § 4)

17.12.080 Optional code election.

A landowner or developer of property in the city of Sequim whose property has been approved for development in conformance with Chapter 17.20 SMC (Subdivisions) and Chapter 17.24 SMC (Binding Site Plans) may elect to have the SMC existing at the time of the election apply to the property and waive the right to have the SMC in existence at the time of the determination of completeness as defined in SMC 20.01.130 apply to the property with respect to current bulk and dimensional standards and/or building codes; provided, that the use of such new regulations does not require changes to recorded documents.

Such election and waiver shall be in writing, acknowledged and filed with the planning department of the city of Sequim and shall be submitted by the owner or owners of all lots, units or divisions in the development or approved separate phase of the development, as the case may be. (Ord. 2007-014 § 1)

Chapter 17.20 SUBDIVISIONS

Sections:

- 17.20.010 Subdivision procedure.**
- 17.20.015 Preapplication conference required.**
- 17.20.020 Submittal documents.**
- 17.20.030 Review required.**
- 17.20.040 Approval criteria.**
- 17.20.050 Dedications and/or easements – Required.**
- 17.20.060 Preliminary plat approval.**
- 17.20.070 Authorization for subdivider.**
- 17.20.080 Expiration and requests for extension.**
- 17.20.090 Expiration of phased development proposals.**

17.20.010 Subdivision procedure.

All applications for subdivision shall be considered by the city, consistent with the requirements of SMC Title 20.

A. Major subdivision shall include those applications for land division which request approval for 10 or more parcels or divisions.

B. Minor subdivision shall include those applications for land division which request approval for nine or less parcels or divisions. (Ord. 98-005 § 4)

17.20.015 Preapplication conference required.

A preapplication conference shall be required for all applications for subdivision, consistent with the requirements of SMC 17.12.015. (Ord. 98-005 § 4)

17.20.020 Submittal documents.

An application for major subdivision or minor subdivision shall include all materials specified in Table 17.12.020(A). (Ord. 98-005 § 4)

17.20.030 Review required.

Review of the proposed application shall include consideration of all public and agency comment or testimony received. The planning director with the assistance of the -city engineer or their designees shall evaluate and determine the engineering accuracy of the proposed subdivision, including but not limited to, the proposed street system including pedestrian connectivity, the proposed sewage disposal system, the proposed reclaimed water connection (for irrigation), the proposed storm drainage system, proposed and potential low impact development (LID) best management practices (BMPs) where site and soil conditions make LID feasible as determined by the City Engineer, and the proposed water supply system. The planning department shall evaluate and determine the proposal's conformance with the comprehensive plan and all zoning requirements. The public works department shall evaluate the application to determine the adequacy of system improvements and capacity. (Ord. 98-005 § 4)

17.20.040 Approval criteria.

The city shall not approve applications for subdivisions unless it is demonstrated by the subdivider that each of the following criteria has been met or will be met:

A. Each lot resulting from the subdivision shall conform to-with the comprehensive plan and zoning regulations;

B. Each lot shall adjoin a public street or a private street in the subdivision;

C. LID BMPs shall be used where site and soil conditions make LID feasible, as determined by the City Engineer and based on the findings from the site analysis process set forth in Section 18.22.015. LID

BMPs shall be consistent with the *LID Technical Guidance Manual for Puget Sound* (current edition) and approved by the City.

D. Curb, gutter, sidewalk, trail connections, transit stops, streets, storm drainage, sanitary sewer lines, water lines and other utilities as required shall be installed at the expense of the applicant and meet city specifications and applicable ordinances and the city engineer has certified or approved the proposed plans;

DE. The subdivider has provided an easement for utilities transmission services, if necessary;

EF. Private property necessary for public use for streets will be dedicated by a deed of dedication acceptable to the city or by preparing a plat to be recorded;

FG. A bond will be posted to ensure completion of those improvements required under these criteria but not yet installed or provided;

GH. Adequate public facilities will be provided, as required by the adopted capital facilities plan. These facilities may include, but not necessarily be limited to, parks, playgrounds, schools, open spaces, transit stops, and trails and trail connections;

HI. All requirements of the environmentally sensitive areas and wetlands sections of the SMC and the State Environmental Policy Act (SEPA) have been met;

IJ. No development may occur which causes a flooding hazard, and until any development occurring within an identified floodplain has been properly mitigated;

JK. The public interest will be served by the proposal;

KL. All the requirements of Chapter 58.17 RCW have been met; and

LM. The proposed project phasing schedule, if applicable, meets the requirements contained in SMC 17.20.090. (Ord. 2007-002 § 1; Ord. 2005-022 § 1; Ord. 2004-015 § 1; Ord. 98-005 § 4)

17.20.050 Dedications and/or easements – Required.

No plat shall be approved unless all areas to be used by the public which are required to be dedicated are conveyed to, and accepted by the city, and all easements which are required as conditions of approval are granted in a form acceptable to the city. (Ord. 98-005 § 4)

17.20.060 Preliminary plat approval.

Preliminary plat approval shall be granted by the city after adoption of findings of fact, conclusions and conditions, which clearly describe the proposed subdivision and the proposals consistent with all applicable review criteria. In addition all conditions which are required to be met prior to final plat approval shall be specifically described in the findings. (Ord. 2005-022 § 2; Ord. 2004-015 § 2; Ord. 98-005 § 4)

17.20.070 Authorization for subdivider.

Approval of the preliminary plat by the city, consistent with the provisions of SMC Title 20, shall constitute authorization for the subdivider to develop the subdivision's facilities and improvements in strict accordance with final design and/or construction drawings which have been reviewed and approved by the public works director, with state laws, this title and all applicable conditions of the preliminary plat approval. (Ord. 2005-022 § 3; Ord. 2004-015 § 3; Ord. 98-005 § 4)

17.20.080 Expiration and requests for extension.

The preliminary plat approval shall expire within three years unless a proposed final plat, in proper form, is submitted to the city planning department; provided, however, that an extension of time, not to exceed one year, may be granted by the city council upon the recommendation of the planning director. Only two such extensions shall be granted. However, any extension of time may require additional review and additional conditions of approval, if in the determination of the planning director or the city council such review or conditions are required. (Ord. 2005-022 § 4; Ord. 2004-015 § 4; Ord. 98-005 § 4)

17.20.090 Expiration of phased development proposals.

Preliminary plats which have been approved for phased development consistent with the requirements of Chapter 17.26 SMC shall submit a proposed final plat (or request for extension in appropriate form) for the first phase of the development within three years of the date of preliminary plat approval. Subsequent phases shall be required to submit proposed final plats within five years of the date of preliminary approval, excepting that the city council may approve an alternative date of expiration for subsequent phases if an approved development agreement consistent with the requirements of SMC Title 20 has been adopted. Additional review and conditions may be required by the city council for any phased final plat which is submitted more than five years from the date of the preliminary plat approval is environmental conditions or regulations have changed. (Ord. 2005-022 § 5; Ord. 2004-015 § 5; Ord. 98-005 § 4)

**Chapter 17.24
BINDING SITE PLANS**

Sections:

17.24.010	Purpose and adoption authority.
17.24.020	Applicability.
17.24.025	Binding site plans – Minor.
17.24.030	Preapplication conference required.
17.24.040	Application.
17.24.050	Fees.
17.24.060	Distribution of plans.
17.24.070	Notice of hearing.
17.24.080	Hearing.
17.24.090	Design regulations.
17.24.100	Preliminary approval and authorization for land divider.
17.24.110	Expiration.
17.24.120	Final binding site plan – Requirements.
17.24.130	Final binding site plan survey requirements.
17.24.140	Final binding site plan approval and filing.
17.24.150	Performance bonds in lieu of required improvements.
17.24.160	Development in conformity with the final binding site plan.
17.24.170	Amendment.

17.24.010 Purpose and adoption authority.

The purpose of this chapter is to establish a binding site plan review procedure as provided for under the authority of RCW 58.17.040(4), (5) and (7). The binding site plan serves as an official land use control pursuant to Chapter 36.70 RCW. Binding site plans provide an alternative to the conventional platting requirements of the State Subdivision Act (Chapter 58.17 RCW) and allow more flexibility in design and operation of manufactured home parks, recreational vehicle parks, condominium developments, multifamily developments, planned unit developments and commercial and industrial developments. (Ord. 98-005 § 4)

17.24.020 Applicability.

A. Binding site plan review and approval pursuant to this chapter shall be required prior to undertaking any of the following actions:

1. Divisions of land for lease for commercial or industrial uses; and/or
2. Divisions of land for lease where no residential structures, other than recreational vehicles are permitted; and/or
3. The establishment of manufactured home parks, where no lots will be sold; and/or
4. The establishment of condominium developments.

B. Binding site plan review and approval pursuant to this chapter may be pursued as an alternative to the subdivision process for any of the following actions:

1. Divisions of land for sale which is restricted to commercial or industrial uses.
2. Multifamily or apartment complex development where no lots are to be sold. (Ord. 98-005 § 4)

17.24.025 Binding site plans – Minor.

Binding site plans which do not require State Environmental Policy Act (SEPA) review, consistent with the requirements of SMC Title 16, may be considered minor binding site plans, and may be reviewed administratively, consistent with the requirements of SMC Title 20. The planning director may determine that an application for binding site plan which does not require SEPA review will be considered a major binding site plan if, in the director's determination, the scope, scale, size or impact of the proposal requires additional review and a public hearing. (Ord. 98-005 § 4)

17.24.030 Preapplication conference required.

A preapplication conference shall be required for all applications for binding site plan approval consistent with the provisions of Chapter 20.01 SMC. Information for a preapplication conference shall be submitted consistent with the requirements of SMC 17.12.015. (Ord. 98-005 § 4)

17.24.040 Application.

Any person with an ownership interest or permission of the owners desiring approval of a binding site plan shall submit the application materials required in SMC 17.12.020(A). (Ord. 98-005 § 4)

17.24.050 Fees.

Application fees shall be paid consistent with SMC Chapter 20.05, Fee Schedule. (Ord. 98-005 § 4)

17.24.060 Distribution of plans.

If in the opinion of the planning department the application contains sufficient data to determine approval or disapproval they shall affix a file name or number and date of receipt to the application, forward copies of the preliminary site plan to the appropriate agencies and officials, and notice the project consistent with the requirements of SMC Title 20, Land Use and Development. (Ord. 98-005 § 4)

17.24.070 Notice of hearing.

The planning department shall provide for notice of the public hearing consistent with the requirements of SMC Title 20, Land Use and Development. (Ord. 98-005 § 4)

17.24.080 Hearing.

In addition to any relevant evidence received from the general public or the parties involved, the city engineer shall evaluate and determine the engineering accuracy of the proposed binding site plan, including but not limited to the proposed street system, the proposed sewage disposal system, the proposed storm drainage system and the water supply system. The planning department shall evaluate and determine the proposal's conformance with the comprehensive plan and all zoning requirements. The public works department shall evaluate the adequacy of utility system improvements and capacity. (Ord. 98-005 § 4)

17.24.090 Design regulations.

The city council shall not approve applications for binding site plan ~~approval~~ unless it is demonstrated by the applicant that each of the following criteria has been met or shall be met:

A. Each use of the land resulting from the adoption of the binding site plan conforms with the comprehensive plan and with zoning regulations, including lot coverage, setbacks, building heights, off-street parking requirements, landscaping buffering and permitted uses within zoning districts;

B. Adequate provisions for on- and off-site circulation and connection with the surrounding road net have been proposed, consistent with adopted city standards;

C. LID BMPs shall be used where site and soil conditions make LID feasible, as determined by the City Engineer and based on the findings from the site analysis process set forth in Section 18.22.015. LID BMPs shall be consistent with the LID Technical Guidance Manual for Puget Sound (current edition) and approved by the City Engineer.

D. Curb, gutter, sidewalk, trail connections, transit stops, streets, storm drainage, sanitary sewer

lines, water lines and other utilities will be installed at the expense of the applicant and meet city specifications and applicable ordinances and the city engineer has certified or approved the proposed plans for the construction;

~~DE~~. The applicant has provided, if necessary, easements to the city to accommodate the establishment of municipal utilities;

~~EF~~. Private property necessary for public use as street rights-of-way have been dedicated to the city by an acceptable deed of dedication or by preparing a plat to be recorded;

~~FG~~. A bond has been posted to ensure completion of those unconstructed improvements required consistent with the criteria found in this chapter;

~~GH~~. Adequate public facilities are provided as required by the adopted capital facilities plan; these facilities may include, but are not necessarily limited to, parks, playgrounds, schools, open spaces, transit stops, and trails and trail connections;

~~HI~~. All requirements of the environmentally sensitive areas and wetlands sections of the SMC and the State Environmental Policy Act (SEPA) have been met;

~~IJ~~. No development shall occur which causes a flooding hazard, and until any development occurring within an identified floodplain has been properly mitigated;

~~JK~~. The public interest will be served by the proposal;

~~KL~~. All the requirements of Chapter 58.17 RCW have been met; and

~~LM~~. All proposed project phasing schedule shall meet the requirements contained in SMC 17.20.090. (Ord. 2005-022 § 6; Ord. 2004-015 § 6; Ord. 98-005 § 4)

17.24.100 Preliminary approval and authorization for land divider.

Preliminary approval of the binding site plan by the city council, consistent with the provisions of SMC Title 20, shall constitute authorization for the applicant and/or project proponent to develop the required facilities and improvements in strict accordance with state laws and the standards contained in this title. (Ord. 2005-022 § 7; Ord. 2004-015 § 7; Ord. 2004-013 § 1; Ord. 98-005 § 4)

17.24.110 Expiration.

The approval given to a binding site plan shall expire within three years following approval unless a proposed final plan, in proper form, is submitted to the city planning department; provided, however, that an extension of time, not to exceed one year, may be granted by the city council upon the recommendation of the planning director. Only two such extensions shall be granted. However, any extension of time may require additional review and additional conditions of approval, if in the determination of the city council such review or conditions are required. (Ord. 2005-022 § 8; Ord. 2004-015 § 8; Ord. 98-005 § 4)

17.24.120 Final binding site plan – Requirements.

The proposed binding site plan shall be submitted in triplicate, including a photo-reproducible mylar copy. Each binding site plan shall consist of one or more pages, each 18 inches wide by 24 inches long, clearly and legibly drawn.

The perimeter of the binding site plan shall be depicted with heavier lines than appear elsewhere on the plan. The scale shall be 50 feet to one inch, unless a different scale is required by the city engineer. A margin of at least one-half inch shall be left around each sheet.

Every final binding site plan shall include an accurate map of the land based on a complete survey consistent with the requirements of this title. The final plan shall contain, but not be limited to the following information:

A. All section, township, municipal and county lines lying within or adjacent to the binding site plan shall be illustrated;

B. A description of all corners necessary to determine the exterior boundaries of the binding site plan and showing bearing and distance ties to a minimum of two monument corners of record which were used for the survey;

C. The boundary of the binding site plan complete with bearing to the nearest one second and lineal dimensions to the nearest one-hundredth of a foot. The location of all proposed building sites located within the boundaries of the binding site plan; provided, that the building sites locations need only be staked, not surveyed and monumented;

D. The length of all straight lines, and the radii, length of arcs and central angles of all curves;

E. The location, width, centerline, ownership and name and number of all streets within and adjoining the binding site plan; the location of all required improvements, including but not limited to street lights, utilities, fire hydrants, parking areas, [LID BMPs \(if installed as required in the preliminary binding site plan-applicable\)](#), sidewalks and trails etc.;

F. The location, width, and descriptions of all easements shall be illustrated by broken lines;

G. A statement identifying the purpose and permitted uses for all common areas other than streets;

H. Dedications to the public or easements granted to the city and/or the lot owners shall be clearly indicated on the face of the final plan;

I. A notice to title shall be included on the face of the plan which indicates that city approval of the binding site plan does not automatically dedicate the use of water, sewer, stormwater, solid waste disposal or other utilities of the city, unless specifically provided for in the preliminary plat approvals, or in an approved development agreement. Potential purchasers of the property should be advised to contact the city for information regarding assessments and fees for utility services;

J. The name and project number of the binding site plan as assigned by the city, a bar scale, north arrow and date of preparation, including revision dates;

K. A legal description of the land contained with the binding site plan;

L. A signed statement by the registered land surveyor who prepared the binding site plan, attesting that it is a true and correct representation of the lands surveyed;

M. The following statement shall be placed verbatim on the face of the plan: "No portion of this binding site plan may be altered, amended, deleted, added to or changed in any manner except by application of amendment to the city of Sequim";

N. A statement of approval by the city engineer;

O. A statement of approval by the county health officer (if septic facilities are proposed);

P. A statement as to the ownership and maintenance agreements governing any proposed common areas. This statement shall reference all lot owners' agreements which are filed concurrently;

Q. Every plan filed for record must contain a certificate giving the full and correct description of the divided lands as they appear on the binding site plan, including a statement that the plan has been made with the free consent and in accordance with the desires of the owners. This statement shall be signed and acknowledged by a notary public;

R. A signed statement by the planning director that the binding site plan has been established consistent with the requirements and conditions of the approved preliminary binding site plan, and that all of the conditions thereof have been met and the plan as established is consistent with all applicable city land controls;

S. A signed statement from the Clallam County treasurer that all taxes have been paid in advance on all property included in the binding site plan;

T. A space for the county auditor to sign the plan for recording purposes;

U. A signed copy of the lot owners' association bylaws, and articles of incorporation, if applicable; and

V. A recent (30-day period) title report specific to the subject property which shows all persons having ownership interest in the property. (Ord. 98-005 § 4)

17.24.130 Final binding site plan survey requirements.

The survey shall be performed in full compliance with the Survey Recording Act, Chapter 58.09 RCW, RCW 58.17.160(3) and 58.24.040. (Ord. 98-005 § 4)

17.24.140 Final binding site plan approval and filing.

A binding site plan shall be approved if the city council finds that the following requirements have been satisfied:

A. The binding site plan is determined to be in conformance with this chapter and contains the signatures and approvals of all of the required officials; and

B. All required on-site and off-site improvements have been installed, and approved by the city, and all outstanding conditions of the preliminary binding site plan approval have been satisfied.

Development permits for on-site buildings and structures (excepting those required to accommodate utility infrastructure) may not be issued until the final binding site plan has been filed by the applicant for the record with the county auditor. (Ord. 98-005 § 4)

17.24.150 Performance bonds in lieu of required improvements.

Performance bonds at a rate of 1.25 times of the estimated cost for required improvements may be accepted in lieu of required improvements for a binding site plan consistent with the requirements of this title. (Ord. 98-005 § 4)

17.24.160 Development in conformity with the final binding site plan.

Following final approval of a binding site plan pursuant to the requirements of this chapter, any and all development and use of the land to which the plan pertains shall be in conformity with all conditions and requirements of final approval. Development undertaken pursuant to the conditions and requirements of an approved binding site plan shall be established consistent with the requirements of all other applicable city and state codes. (Ord. 98-005 § 4)

17.24.170 Amendment.

An approved binding site plan may be amended upon application to the planning director. The applicant must make the request to amend the binding site plan in writing. The planning director shall approve the amendment if it meets all of the following criteria:

A. No new building pads are proposed;

B. No building shall be greater than 10 percent larger than shown of the final binding site plan; and

C. The amendment would not result in increased amounts of traffic, nor propose circulation patterns which are different than those proposed by the original application, nor significantly increase or cause unanticipated environmental impacts.

All amended site plans shall meet the requirements associated with a final site plan as described in SMC 17.24.120. All amendments shall be numbered successively (i.e., first amendment to the binding site plan).

If the proposed amendment does not meet the above referenced criteria, a new binding site plan application shall be required. (Ord. 98-005 § 4)

Chapter 17.28 GENERAL DESIGN STANDARDS

Sections:

- 17.28.010 Purpose.
- 17.28.020 Subdivision and site design – Site analysis recommended.
- 17.28.025 Subdivision and site design – Performance standards.
- 17.28.030 Trees.
- 17.28.035 LID and Native vegetation.
- 17.28.040 Landscape design.
- 17.28.050 Open space and recreation.

17.28.010 Purpose.

Good subdivision design is critical to the establishment of a functional and attractive development which minimizes adverse impacts to the environment and ensures that the project will be an asset to the community. To promote this purpose, all subdivisions and/or site plans shall conform to the standards contained in this chapter. These standards have been designed to assist in the development of a well-planned and constructed subdivision without adding unnecessarily to development costs. (Ord. 98-005 § 4)

17.28.020 Subdivision and site design – Site analysis ~~recommended~~ required.

A site analysis of the proposed subdivision and/or binding site plan project shall be completed in accordance with the requirements of Section 18.22.015 SMC.

~~location and surrounding properties should be made to ensure that all of the natural and constructed characteristics of the site are considered in the preparation of the preliminary plat. The purpose of the site analysis is to assist the applicant in the preparation of the preliminary plat by identifying constraints and opportunities found on site. Preparation of the site analysis, prior to preapplication conference, can provide substantial assistance in facilitating project review. The site analysis may include text and/or may be indicated graphically on a scaled base map. The site analysis should include:~~

~~A. General Site Context. The general site context includes adjacent land use patterns, circulation systems, population characteristics, ecological and hydrographic systems of region, area economy, nearby projects and their effects on the site.~~

~~B. Physical, Historical and Cultural Data. The physical, historical and cultural data associated with the site and adjacent land, usually comprised of the following:~~

~~1. Geology and soil, including soil types found on the site and their depth, any identified areas of fill, and any portions of the site which are located within aquifer recharge areas.~~

~~2. Water, including bodies of water found on or adjacent to the site, the drainage pattern of the site and surrounding areas, the depth to the water table, the availability of on or off site water supplies, and the location of the site or the surrounding area within a floodplain.~~

~~3. Topography, including the topographic pattern of land forms found on the site and in the immediate area, any unique topographic features found on the site, and the location and inclination of slopes found on the site and in the surrounding area.~~

~~4. Plant and animal communities, including the pattern of plant cover and the location of any unique or rare specimens on site or in the surrounding community.~~

~~5. Manmade structures, including existing buildings, road and path networks, and the location and condition of utilities on site or in the surrounding area.~~

~~6. Visual qualities, including the character and relationship of visual spaces, viewpoints or vistas on site or as seen from the site, and potential focal points on site or as seen from the site.~~

~~7. Use, including the nature and location of current land uses on site and in the immediate area,~~

~~an assessment of who is participating in the existing uses, property ownership patterns, existing on-site easements, existing zoning, and the applicability of subdivision and other regulations. (Ord. 98-005 § 4)~~

17.28.025 Subdivision and site design – Performance standards.

A. Structures and infrastructure shall be located, to the maximum extent practicable, in a manner ~~which~~that preserves the natural features of the site, avoids environmentally sensitive areas and wetlands, and minimizes adverse impact and alteration of natural features.

B. The following specific areas shall be preserved as undeveloped open space as required by applicable codes and plans:

1. Wetlands and environmentally sensitive areas including streams, stream corridors, ravines, geologically hazardous areas, wildlife habitat areas and shorelines, as defined by the city of Sequim wetlands and environmentally sensitive areas ordinances and the city of Sequim shoreline management master plan.

2. Lands located within floodplains, as defined by the Sequim Municipal Code. If any portion of the land within the boundary of a preliminary plat or approved record of survey is subject to flood or inundation or is in a flood control zone, consistent with Chapter 86.16 RCW, that portion of the subdivision shall have the written approval of the Department of Ecology before the city council shall hear the final plat.

3. Development shall be laid out to avoid adversely affecting groundwater and aquifer recharge, to reduce cut and fill, to avoid unnecessary impervious surfaces, to prevent flooding, to provide adequate access to all lots and sites, and to mitigate adverse impacts relating to shadow, glare, traffic, odors and drainage on neighboring properties. (Ord. 98-005 § 4)

17.28.030 Trees.

A. Every reasonable effort shall be made to preserve existing trees. Trees with a minimum 8-inch diameter at breast height (d.b.h.) shall be preserved unless they are dead, dying, diseased, or if their preservation makes site development unduly burdensome.

B. If preservation of the existing trees would enhance the appearance of the subdivision, or prevent erosion and other negative environmental effects, the city may impose tree cutting restrictions on trees eight inches in diameter or larger. Such restrictions shall be noted on the face of the final plat and shall run with the land. (Ord. 98-005 § 4)

17.28.035 LID and Native vegetation.

A. All subdivisions and/or binding site plan projects which have a site analysis which proves that a low impact development is feasible, as determined by the City Engineer, shall comply with the LID BMPs and native vegetation requirements are set forth in 18.22.035 and 18.22.045 SMC.

17.28.040 Landscape design.

A. Reasonable landscapings should be provided at the site entrances, in public areas, and adjacent to buildings. The type and amount of landscaping shall be allowed to vary consistent with the type of development and the requirements of the zoning district.

B. Landscaping materials shall be those which best serve the intended function, and shall be appropriate for the soil and other environmental conditions of the site. Drought-tolerant, low water plant materials shall be encouraged.

C. The successful establishment and long-term maintenance of landscaping features shall be addressed. (Ord. 98-005 § 4)

D. To the extent feasible as determined by the City Engineer, landscaping shall use plants native to the local area and the Pacific Northwest.

E. Where site and soil conditions permit, landscaping may be dual purpose in providing an aesthetic function as well as an LID stormwater management function. Integrating LID stormwater management facilities into landscape design shall be allowed provided that:

1. The intent of the landscaping is not compromised;
2. LID facilities are designed and constructed in accordance with the *LID Technical Guidance Manual for Puget Sound* (current edition);

17.28.050 Open space and recreation.

Major subdivision, minor subdivision and binding site plan developments shall be required to provide open space proportional to their impact. Developed open space shall be designed to provide active recreational facilities to serve the residents of the development. Undeveloped open space shall be designed to preserve important site amenities and environmentally sensitive areas.

A. Minimum Requirements. Open spaces shall be provided proportionally to anticipated impacts associated with the proposed subdivision.

1. Minor subdivisions located in residential zones which provide standard yards and setbacks consistent with the zoning code shall be determined to have provided adequate open space.

2. Subdivisions located in residential zoning districts, other than minor subdivisions, shall provide a minimum of 10 percent open space, at least half of which shall be designed for active recreational uses, excepting where open space set aside to protect critical areas, as required by the SMC, exceeds 20 percent of the proposed project area. Easements for trails, excepting those trails constructed in lieu of sidewalks, may be considered as meeting the active recreational open space requirements.

3. Binding site plan developments and commercial and industrial subdivisions shall provide a minimum of 10 percent open space which may provide for either passive and/or active open space, and which may include required landscaped areas, stormwater detention facilities, irrigation ditches and easements, and other environmentally sensitive area open spaces. Easements for trails, excepting those trails constructed in lieu of sidewalks, may be considered as meeting the open space requirements.

4. Proposed open space areas designed for active recreational use shall be concentrated in large areas so as to be functionally usable.

5. Active open space parcels shall be conveniently located in relation to the dwelling units they are intended to serve.

B. Improvements to Open Space Dedications.

1. Improvements to active open space dedications may be required to mitigate the anticipated recreational impacts of the proposed development.

2. Improvements shall seek proportionality in the character of the open space and the intended active recreational use, and the cost of the recreational facilities.

3. Major subdivisions located within 600 feet of an existing municipal recreational facility may provide a contribution in lieu of establishing an active open space. In the instance where the recreational level of service (LOS) for a given area has been successfully fulfilled by the establishment of an off-site facility, the requirements for the contribution may be waived.

4. Whenever practicable, undeveloped open space should be left in its natural state. Enhancement may be allowed to provide approved trails, to thin and remove diseased trees, and to enhance vegetation or to provide view corridors.

C. Exceptions to the Standards. The city council or planning director, as applicable, may permit minor deviations from the open space standards when it can be determined that:

1. The objectives of these standards may be met without strict adherence to the open space requirements; and/or

2. Due to the existing conditions found on the tract of land or facilities proposed, strict adherence to these standards would be unreasonable.

D. Deed Restrictions. Any lands dedicated for open space purposes shall contain appropriate covenants and deed restrictions ensuring that:

1. The open space will not be further subdivided in the future;

2. The use of the open space will continue in perpetuity for the purpose specified; and

3. Appropriate provisions will be made for the maintenance of designated open space areas.

E. Open Space Ownership. The form of ownership of the land proposed for open space purposes shall

be selected by the applicant, subject to approval of the city. Forms of ownership may include, but are not necessarily limited to, the following:

1. Ownership by the city, or other local jurisdiction, contingent on acceptance by the governing body;

2. Ownership by quasi-public entities or jurisdictions, conditioned upon their acceptance;

3. Ownership by homeowner, condominium owner or cooperative associations or organizations;

4. Ownership by individual lot owners, if the open space is wholly located within one tract or lot;

or

5. Ownership by a shared or undivided interest of all property owners within the subdivision.

(Ord. 98-005 § 4)

Chapter 17.32 STREET DESIGN STANDARDS

Sections:

- 17.32.010** **Conformity to roadway functional classification system.**
- 17.32.020** **Relation to adjoining street system.**
- 17.32.030** **Arterials and intersections.**
- 17.32.040** **Local roads.**
- 17.32.050** **Minimum widths.**
- 17.32.060** **Topography.**
- 17.32.070** **Full width streets.**
- 17.32.080** **Existing streets.**
- 17.32.090** **Private streets.**
- 17.32.095** **Shared driveways – Common drives**
- 17.32.100** **Vertical curves.**
- 17.32.110** **Two access points required.**
- 17.32.120** **Grades.**
- 17.32.130** **Centerlines.**
- 17.32.140** **Storm management.**
- 17.32.150** **Access to arterials and collectors.**
- 17.32.160** **Easements.**
- 17.32.170** **Sidewalks.**
- 17.32.180** **Street name signs.**
- 17.32.190** **Street lighting.**

17.32.010 **Conformity to roadway functional classification system.**

A. The proposed street system of any subdivision shall conform to the roadway functional classification system as adopted by the Sequim comprehensive plan.

B. In order to provide the most advantageous development of the proposed subdivision and adjacent area, the subdivision shall provide for the continuity of streets and utilities and shall conform to the standard drawings included in the City of Sequim Streets and Utilities Development Regulations (SUDR).

C. Streets shall be constructed consistent with the minimum street design standards identified in the City of Sequim SUDR Detail SQM-R1A, R1B, R2A, R2B and R2C. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

D. The use of Low impact development (LID) best management practices (BMPs) in street design and construction shall be required whenever site and soil conditions make LID a feasible option, as determined by the City Engineer. LID streets and best management practices shall be consistent with the City of Sequim SUDR LID Details SQM-R1A, R1B, R2A, R2B and R2C the LID Technical Guidance Manual for Puget Sound (current edition), and approved by the City.

17.32.020 **Relation to adjoining street system.**

A. The proposed street system shall extend existing streets at the same or greater width, but in no case less than the required minimum width.

1. When existing streets are determined by the public works director to be wider than the required width, and safety concerns can be met, the developer may be permitted to provide for a transition between the "over-wide" street and the new street.

B. Streets shall intersect at right angles, or as nearly so as possible.

C. Intersections of streets shall be designed so as to avoid "dog-legs." The minimum distance between intersections shall be 125 feet unless a different distance is approved by the city engineer.

D. All streets, curbs, trails and sidewalks shall be improved to the full width of the dedication

continuing from intersection to intersection. On streets where the dedication does not continue from intersection to intersection, the improvements shall be continuous from intersection to subdivision boundary. On streets where a proposed subdivision adjoins an existing subdivision or existing street dedication in midblock and the existing subdivision or existing street dedication is unpaved, the subdivider shall be responsible for paving that portion of the street within the existing subdivision or street dedication to the next intersection.

E. All dead-end streets or alleys shall terminate in a cul-de-sac having a minimum right-of-way diameter of 100 feet with a 90-foot paved portion. Length of the cul-de-sac shall not exceed 400 feet and shall be measured to the center of the cul-de-sac. Turnarounds may be utilized if designed consistent with WSDOT standards. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.030 Arterials and intersections.

Streets intersecting with minor arterials shall be held to a minimum, subject to review and approval by the public works director. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.040 Local roads.

Local roads shall be so laid out that their use by through traffic will be minimized. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.050 Minimum widths.

A variety of right-of-way and improvement widths are required to address the range of development types and their traffic generation, consistent with the requirements identified in the City of Sequim SUDR Details SQM-R1A, R1B, R2A, R2B and R2C. Right-of-way widths greater than the minimum widths may be required. In steep hillside areas, the right-of-way width, street widths and sidewalk requirements shall be reviewed and shall be developed as recommended by the appropriate City Engineer or Public Works Director departments. (Ord. 2006-019 § 3; Ord. 98-005 § 4) A variety of driving lane widths within the right-of-way may be approved by the City in order to accommodate LID techniques in the street design.

17.32.060 Topography.

The placement of streets and lots in relation to topography shall be considered in order to minimize filling, grading or other alterations of existing conditions. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.070 Full width streets.

All streets shall be platted at full width, and no boundary streets at less than full width in accordance with the City of Sequim SUDR Details SQM-R1A, R1B, R2A, R2B and R2C. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.080 Existing streets.

Whenever existing opened or undeveloped streets adjacent to or within a tract are of inadequate width, additional right-of-way shall be provided at the time of subdivision. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.090 Private streets.

Private streets are only allowed in gated communities, and the following criteria shall be met:

- A. Overall city-wide circulation would not be adversely impacted;
- B. Every subdivision shall provide at least one access to a publicly dedicated street. See SMC 17.32.110;
- C. There shall be no privately owned parcels or rights-of-way which landlock, deny or control access to, or create unrestricted/uncontrolled access to the street system;
- D. Public pedestrian access shall be provided by trails or sidewalks;
- E. A maintenance agreement for the private street is recorded, consistent with Chapter 17.64 SMC;
- F. All private streets shall meet all requirements of public streets; and

G. The subdivision is designed to be a gated community with a human or electronically controlled gate with immediate access provided to all city, garbage, emergency and other official vehicles. (Ord. 2007-002 § 2; Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.095 Shared driveways – Common drives.

A) Shared and common driveways provide the required traveled path to or through a parking lot for multiple single family dwellings, multi-family structures and commercial developments. These “driveways” provide vehicular access for a single family, multi-family and commercial developments. All areas identified within developments which are intended for shared, routine use and/or passage during all hours by all residents and their guests shall be noted on the face of the preliminary and final plats and/or site plans. Shared driveways and common drives shall be designed to meet the below criteria:

1. The use of Low impact development (LID) best management practices (BMPs) in shared and common driveway construction shall be required whenever site and soil conditions make LID a feasible option, as determined by the City Engineer;
2. Adequate ingress/egress for fire apparatus shall be provided as approved by the Public Works Director after consultation with the Clallam County Fire Department; and
3. In no circumstance shall a shared or common driveway be less than 9-feet in width.

17.32.100 Vertical curves.

All changes in grade shall be connected by vertical curves as required for sight distance by the city engineer and in conformance with AASHTO and WSDOT standards. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.110 Two access points required.

Each subdivision shall have at least two points of access, except for those minor subdivisions with nine or fewer lots. The two points of access may be combined if separated by a minimum 10-foot-wide landscape area and encompass two 20-foot-wide drive lanes. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.120 Grades.

Street grades shall conform in general to the terrain and shall be consistent with AASHTO and WSDOT standards. Street grades shall be such as to provide natural surface drainage of storm water regardless of the presence or absence of storm sewers. The intent of this section is to avoid creating depressions or inverts which will flood in flash storms and for which storm sewers are inadequate. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.130 Centerlines.

Street pavement centerlines shall coincide with the centerline of the right-of-way where practical. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.140 Storm management.

Streets shall have storm provisions for stormwater management and control consisting of the proper size pipe and catch basins, or stormwater collection system or LID stormwater management facilities, or open ditch, bio-swaes or bio-retention ditches consistent with the requirements of SMC Title 13, ~~Division V~~, Stormwater Management. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

LID stormwater management facilities such as bioretention swales are preferred where site and soil conditions make LID feasible as determined by the City Engineer. LID stormwater management facilities shall be consistent with SMC Title 13 and the LID Technical Guidance Manual for Puget Sound (current edition).

17.32.150 Access to arterials and collectors.

Lots adjacent to arterials shall be laid out so as to provide access to streets other than arterials. Lots

adjacent to collector streets shall be laid out so as to avoid direct access to the collector, if an access road can be provided. A waiver of direct access shall be required as a condition of approval. If the project proponent presents proof that direct access to such lots from collector streets is essential to facilitate the development of the subject property, and can provide a turnaround on the affected lots to prevent backing out onto collector streets, the city council or planning director, where applicable, may permit direct access. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.160 Easements.

Areas occupied by road-access easements shall not be included in the computation of the minimum area or the minimum width requirement of the lot. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.170 Sidewalks.

All arterials and collector streets except those located within R-I zones shall have sidewalks with a minimum width of six feet in residential areas or eight feet in commercial or mixed use areas. In any situation where the planning director, school district, city engineer, public works director or other reviewing agency recommend sidewalks to serve the public interest or obviate a potential safety hazard, the city council or planning director, as applicable, may require sidewalks to be installed. Exceptions to sidewalk requirements, such as sidewalks on one side of the street, may be approved by the City in order to accommodate LID BMPs.-

A. Off-street bikeways and walkway systems, pathways and/or trails may be considered in lieu of sidewalks as required by this section.

B. Sidewalks shall be located on the public right-of-way contiguous to the property line to prevent interference or encroachment by fencing, walls, hedges, or other planting or structures. Wider sidewalks may be required to match existing development, along arterials and major and minor collectors, and to meet public health and safety concerns. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

C. Permeable surfacing shall be used for sidewalks when site and soil conditions make permeable surfacing feasible as determined by the City Engineer in conformance with SMC, 12.08. Permeable surfacing shall be consistent with the manufacturer's recommendations and the standards set forth in the LID Technical Guidance Manual for Puget Sound (current edition).

17.32.180 Street name signs.

A. Street name signs shall be placed at all intersections within or abutting the subdivision. Such signs shall be of a standard type as approved by the city public works director.

B. The subdivider shall reimburse the city for the cost of the street name signs and the installation necessary in the subdivision.

C. Street names shall be approved by the public works, fire and police departments to prevent duplication and facilitate efficient emergency response. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

17.32.190 Street lighting.

Additional street lighting may be required by the public works director to address issues of public health and safety. (Ord. 2006-019 § 3; Ord. 98-005 § 4)

18.08 - Definitions

“Lot coverage” means the total ground coverage of all impervious surfaces including, but not limited to, roof coverage of all buildings or structures ~~on a site measured from the outside of external walls or supporting, but not to include at grade,~~ offstreet parking lots; deck areas; terraces; swimming pools; pool deck areas; walkways; roadways; and driveways.

Chapter 18.22 DEVELOPMENT STANDARDS

Sections:

18.22.010	Purpose.
<u>18.22.015</u>	<u>Site analysis required.</u>
18.22.020	Buffers.
18.22.030	Sidewalks.
<u>18.22.035</u>	<u>Low Impact Development (LID).</u>
18.22.040	<u>Clearing and</u> Grading.
<u>18.22.045</u>	<u>Tree retention and Native Vegetation Standards.</u>
18.22.050	Industrial use.
18.22.060	Multifamily residential.
18.22.070	Commercial uses.
18.22.075	Mini-storage and self storage facilities.
18.22.080	Mixed use.

18.22.010 Purpose.

Development standards are established to ensure compatibility of uses permitted within the city and to ensure the protection of the public health, safety and general welfare. (Ord. 97-019 § 4, Exh. B)

18.22.015 Site analysis required.

A. Exemptions: Single-family lots of record shall not be required to perform a site analysis.

B. Site Analysis Requirements. A site analysis of the proposed ~~subdivision and/or binding site plan~~ project location and surrounding properties ~~should~~ shall be made to ensure that all of the natural and constructed characteristics of the site are considered in the preparation of the preliminary plat. The purpose of the site analysis is to assist the applicant in the preparation of the preliminary ~~plat-site design~~ by identifying constraints and opportunities found on-site. Preparation of the site analysis, prior to preapplication conference, can provide substantial assistance in facilitating project review.

The site analysis will also provide important baseline information about the potential for incorporating low impact development (LID) best management practices (BMPs) on-site. The use of LID BMPs are required where site and soil conditions make LID feasible, as determined by the City Engineer. LID site design is intended to complement the predevelopment conditions on the site through design strategies that preserve natural resources, preserve areas most appropriate to evaporate, transpire, and infiltrate stormwater, and achieve the goal of maintaining pre-development natural hydrologic conditions on the site.

C. Site Analysis - Graphic Information Required: The site analysis shall be represented graphically on a series of scaled maps. All maps shall include a north arrow and scale bar, and maps can be combined as hard copies or as GIS layers to delineate the best areas to direct development. Designated development areas, which will contain all impervious surfaces and landscaped areas on the site, shall be configured to minimize soil and vegetation disturbance, buffer critical areas, and take advantage of a site's natural stormwater processing capabilities. Designated development area boundaries shall be delineated on site plans and identified on the site during site preparation and construction. Areas outside of the designated development area envelope shall be designated Native Vegetation Areas or reserve areas.

The site analysis shall be a component of the project submittal. The site assessment plan(s) shall include, at a minimum, the following graphic information:

1. General Site Context. The general site context includes adjacent land use patterns, circulation systems, population characteristics, ecological and hydrographic systems of region, area economy, nearby projects and their effects on the site.

2. –Manmade structures, including existing buildings, road and path networks, and the location and condition of utilities on-site or in the surrounding area.
3. –Visual qualities, including the character and relationship of visual spaces, viewpoints or vistas on-site or as seen from the site, and potential focal points on-site or as seen from the site, which exist at the time a development is proposed.
4. Use, including the nature and location of current land uses on-site and in the immediate area, an assessment of who is participating in the existing uses, property ownership patterns, existing on-site easements, existing zoning, and the applicability of subdivision and other regulations. (Ord. 98-005 § 4)
5. A survey prepared by a registered land surveyor or registered civil engineer showing existing public and private development, including utility infrastructure, on and adjacent to the site, major and minor hydrologic features, including seeps, springs, closed depression areas, drainage swales, and contours as follows:
 - a. Up to 10 percent slopes, two-foot contours.
 - b. Over 10 percent to less than 20 percent slopes, five-foot contours.
 - c. Twenty percent or greater slopes, 10-foot contours.
 - d. Spot elevations shall be at 25 foot intervals.
6. Location of all existing lot lines, lease areas and easements, and the location of all proposed lot lines, lease areas, and easements.
7. A soils report prepared by a licensed geotechnical engineer or licensed engineering geologist. The report shall identify:
 - a. Underlying soils on the site utilizing soil pits and soil grain analysis to assess infiltration capability on site. The frequency and distribution of soil pits shall be adequate to direct placement of the roads and structures away from soils that can most effectively infiltrate stormwater.
 - b. Topologic features that may act as natural stormwater storage or conveyance and underlying soils that provide opportunities for storage and partial infiltration.
 - c. Depth to groundwater.
 - d. Geologic hazard areas and associated buffer requirements as defined in Chapter 18.80 SMC.
8. A survey of existing native vegetation cover by a licensed landscape architect, arborist, qualified biologist identifying any forest areas on the site, species and condition of ground cover and shrub layer, and tree species, and canopy cover. Garry Oaks, a Sequim significant species of tree shall be separately cataloged by a qualified arborist.
9. A survey of wildlife habitat by a qualified biologist, including the pattern of plant cover and the location of any unique or rare specimens on-site or in the surrounding community.
10. A streams, wetland, and water body survey and classification report by a qualified biologist showing wetland and buffer boundaries on or within 200 feet of the site. The report shall be consistent with the requirements of Chapter 18.80 SMC, if present.
11. Flood hazard areas on or within 200 feet of the site, if present.
12. Aquifer and wellhead protection areas on or within 200 feet of the site, if present.
13. Any known historic, archaeological, and cultural features located on or adjacent to the site, if present.

D. Site Analysis – Textual Information Required:

The applicant must respond to each of the items below but the response may include estimates or approximations where exact figures are not known at the time of submittal. All estimates should be based on the applicant's best knowledge and intent of the proposal. When estimates or approximations are used they must be identified as such. The applicant should be aware that any estimates or approximations provided may be used to set development conditions or thresholds. Required textual information includes:

1. Site context:

- a. Total gross area of the site;
- b. Total project area (total gross site area minus total reserve area);
- c. Total area of designated development area;
- d. Proposed number of dwelling units by type;
- e. Conventional impervious surface assumptions used for volume reduction calculations;
- f. Maximum impervious surface proposed for each lot;
- g. Lot sizes and dimensions;
- h. Total area of impervious surfacing;
- i. Proposed ownership of land areas, streets, and alleys within the project both during and after construction;
- j. Gross density of dwelling units;
- k. Description of the potential and/or proposed LID BMPs for the site, including location and dimensions.
- l. Requested dimensional modifications;
- m. Development schedule indicating the approximate date when construction of the project or stages of the project can be expected to begin and be completed.
2. Preliminary drainage report as described in Title 13. TThe report should clearly state the assumed conventional storage volume and LID storage volume in the introduction.

~~The site analysis may include text and/or may be indicated graphically on a scaled base map. The site analysis should include:~~

~~A. General Site Context. The general site context includes adjacent land use patterns, circulation systems, population characteristics, ecological and hydrographic systems of region, area economy, nearby projects and their effects on the site.~~

~~B. Physical, Historical and Cultural Data. The physical, historical and cultural data associated with the site and adjacent land, usually comprised of the following:~~

~~1. Geology and soil, including soil types found on the site and their depth, any identified areas of fill, and any portions of the site which are located within aquifer recharge areas.~~

~~2. Water, including bodies of water found on or adjacent to the site, the drainage pattern of the site and surrounding areas, the depth to the water table, the availability of on or off site water supplies, and the location of the site or the surrounding area within a floodplain.~~

~~3. Topography, including the topographic pattern of land forms found on the site and in the immediate area, any unique topographic features found on the site, and the location and inclination of slopes found on the site and in the surrounding area.~~

~~4. Plant and animal communities, including the pattern of plant cover and the location of any unique or rare specimens on site or in the surrounding community.~~

~~5. Manmade structures, including existing buildings, road and path networks, and the location and condition of utilities on site or in the surrounding area.~~

~~6. Visual qualities, including the character and relationship of visual spaces, viewpoints or vistas on site or as seen from the site, and potential focal points on site or as seen from the site.~~

~~7. Use, including the nature and location of current land uses on site and in the immediate area, an assessment of who is participating in the existing uses, property ownership patterns, existing on-site easements, existing zoning, and the applicability of subdivision and other regulations. (Ord. 98-005 § 4)~~

18.22.020 Buffers.

All uses located within the city shall be subject to the following development standards, as applicable:

A. Buffers Required Between Zoning Districts. All commercial and mixed uses permitted in "C," "M," and "MU" classified zones having a common boundary with an established residential property or with any portion of a residential zoning district shall establish and maintain along such common

boundaries a buffer area of trees, shrubs, and/or berming. The buffer shall be no less than eight feet wide. The effect of the buffer shall be to partially screen and provide visual relief as measured at eye level from the adjacent residential properties to the commercial or mixed use. Existing plantings and/or topographic and/or natural features that meet or exceed this standard may be considered in lieu of new buffer construction. The retention of existing natural buffer features is preferred, Screening and buffering shall be encouraged within areas between permitted uses.

1. Buffer Design. Arrangements of plantings in buffers shall partially obscure at eye level the view from residential properties to the adjacent commercial and/or mixed use. Where possible, existing plant material should be preserved and/or enhanced. Possible arrangements include planting in parallel, serpentine, or broken rows. If planted berms are proposed, the minimum top width shall be four feet, and the maximum side slope shall be 2:1. A combination of plantings and fences may be permitted in the buffer area.

2. Planting Specifications. Plant materials shall be sufficiently large and planted in such a fashion that a year-round screen of at least eight feet in height shall be produced within two sequential growing seasons. All plantings shall be installed according to accepted horticultural standards.

3. Maintenance. Plantings shall be maintained in a manner appropriate for the specific plant species through the initial growing seasons. Dead and dying plants shall be replaced during the next growing season, and shall be subject to the subsequent replacement for the next two sequential growing seasons occurring chronologically from the above referenced date of planting. Buffer areas shall be maintained and kept free of all debris, rubbish, weeds, and tall grass. (Ord. 97-019 § 4, Exh. B)

18.22.030 Sidewalks.

Sidewalks shall be established consistent with the following standards:

A. Sidewalks To Be Constructed in Commercial and Mixed Use Districts. If the street grade has been previously approved by the public works director, or if the curbs and gutters are currently in place along the access road abutting the subject property, then any new construction or remodel of the primary structure of that property for all uses permitted within any commercial or mixed use district shall require the property owner to provide and fully develop sidewalks along the entire frontage of the subject property in compliance with the sidewalk construction standards of this chapter prior to issuance of a building permit for said construction.

B. Minimum Sidewalk Development Standards. Sidewalks shall be established consistent with adopted City of Sequim Streetscape Standards. The standards contained within SMC Titles 12 and 17, (Streets, sidewalks and Public Places) and Subdivisions, and the Public Works Handbook and/or to match existing adjacent sidewalks. Where sidewalk depths are inconsistent a transition area shall be provided to avoid hazardous conditions. (Ord. 97-019 § 4, Exh. B) In order to accommodate LID stormwater management facilities, alternative sidewalk and street design may be approved by the City. LID sidewalk and street design shall be consistent with Title 12, the LID standard drawings in the City of Sequim's Streets and Utilities Development Regulations (SUDR) and the LID Technical Guidance Manual for Puget Sound (current edition).

18.22.035 Low Impact Development (LID).

The goal of low impact development is to conserve and use existing natural site features, to integrate distributed, small-scale stormwater controls, and to prevent measurable harm to streams, lakes, wetlands, and other natural aquatic systems from commercial, residential, or industrial development sites by maintaining a more hydrologically functional landscape.

A. Exemption. Single-family lots of record shall be exempt from the requirements of this Section. All commercial remodel projects shall be subject to the requirements of this Section only when the improvement value is 50 percent or greater of the current year's assessed building value as calculated pursuant to the adopted building code.

B. Design and Development Standards. Conformance to the following criteria is required for all development reviewed under the provisions of this Section unless demonstrated that site and soil

conditions make the LID requirements infeasible, as determined by the City Engineer:

1. All projects shall meet the minimum peak and duration flow control standards per the most current edition of the *Stormwater Management Manual for Western Washington*.
2. Through the use of LID integrated management practices identified in the current edition of the *LID Technical Guidance Manual for Puget Sound*, flow control facilities may be reduced in size as calculated under the current edition of the *Stormwater Management Manual for Western Washington*.
3. Water quality treatment BMPs shall be provided to treat 91 percent of the annual runoff volume per the Department of Ecology standards.
4. All areas subject to clearing and grading that have not been covered by impervious surfaces, incorporated into a drainage facility or engineered as structural fill or slope shall, at project completion, shall comply with Chapter 18.23 SMC.
5. After the certificate of occupancy is issued, there shall be no net increase in effective impervious surfaces for all projects.
6. All projects shall provide a maintenance plan/program that has been approved by the City, including source control BMPs.
7. Projects shall reduce the volume of conventional detention facilities (e.g., ponds, vaults, etc.) as follows:
 1. Calculate the volume of a conventional project by using the conventional modeling assumptions in Table 18.22.035-2: Impervious Surface Maximum Limits and Modeling Assumptions.
 2. Reduce the conventional volume by the percentage shown in Table 18.22.035-1: Volume Reduction Requirement to find the allowed LID volume.
 3. Apply sufficient LID techniques to the project so that when the techniques are modeled using guidance from Chapter 7 of the *LID Technical Guidance Manual for Puget Sound* (January 2005 or as amended) the conventional volume is reduced to the required volume reduction percentage found in Table 18.22.035-1.

TABLE 18.22.035-1: Volume Reduction Requirement

<u>Proposed Use⁵</u>	<u>Minimum Volume Reduction (Infiltration < 0.30 in/hr) ^{1,2}</u>	<u>Minimum Volume Reduction (Infiltration of > 0.30 in/hr) ^{1,2}</u>
<u>Non-Multifamily Residential 3.5-4.9 du/ac⁴</u>	<u>50%</u>	<u>60%</u>
<u>Non-Multifamily Residential 5.0-6.9 du/ac⁴</u>	<u>40%</u>	<u>60%</u>
<u>Non-Multifamily Residential 7.0-9.9 du/ac⁴</u>	<u>40%</u>	<u>60%</u>
<u>Non-Multifamily Residential ≥10.0 du/ac ⁴</u>	<u>40%</u>	<u>60%</u>
<u>Multi-Family^{3,4}</u>	<u>40%</u>	<u>80%</u>
<u>Commercial⁴</u>	<u>40%</u>	<u>80%</u>

¹ The volume reduction in the table represents a reduction as compared to the volume needed for a detention volume serving a standard development.

- ² Infiltration rates are as measured in the field at the proposed LID location using techniques recommended in the *Stormwater Management Manual for Western Washington* (current edition) and the *LID Technical Guidance Manual for Puget Sound* (current edition). For sites with varying infiltration rates, the lower infiltration rate shall determine the volume reduction goals.
- ³ Multi-family projects are those projects containing more than four dwelling units attached in a single structure, regardless of ownership mechanism.
- ⁴ Dwelling units per acre is based on gross density.

<u>Table 18.22.035-2: Impervious Surface Maximum Limits and Modeling Assumptions¹</u>		
<u>Proposed Use²</u>	<u>Conventional % Impervious: Modeling Assumption</u>	<u>Conventional % Turf: Modeling Assumption</u>
<u>Non-Multifamily Residential ≤1.4 du/ac</u>	<u>15%</u>	<u>85%</u>
<u>Non-Multifamily Residential 1.5-2.4 du/ac</u>	<u>25%</u>	<u>75%</u>
<u>Non-Multifamily Residential 2.5-3.4 du/ac</u>	<u>35%</u>	<u>65%</u>
<u>Non-Multifamily Residential 3.5-4.9 du/ac</u>	<u>40%</u>	<u>60%</u>
<u>Non-Multifamily Residential 5.0-6.9 du/ac</u>	<u>50%</u>	<u>50%</u>
<u>Non-Multifamily Residential 7.0-9.9 du/ac</u>	<u>60%</u>	<u>40%</u>
<u>Non-Multifamily Residential ≥10.0 du/ac</u>	<u>80%</u>	<u>20%</u>
<u>Multifamily Residential</u>	<u>90%</u>	<u>10%</u>
<u>Commercial</u>	<u>90%</u>	<u>10%</u>

- ¹ Impervious area includes all hard surfaces that impede infiltration of rainfall into the underlying soil profile. Many LID Techniques improve the ability of water to infiltrate into the soil. These techniques count against the impervious surface totals only to the extent indicated by Chapter 7 of the *LID Technical Guidance Manual for Puget Sound* (January 2005 or as amended).
- ² Dwelling units per acre is based on gross density.

18.22.040 Clearing and Grading, ~~tree retention and general site repair.~~

Where reasonable and practicable, all development shall be designed in a manner which maintains existing natural features and grade, significant trees and/or other landscape features, and restores features damaged during development consistent with ~~Comprehensive Plan Policies ENV 3, ENV 4, OSR 11 through 14. The following standards shall be considered: See Chapter 18.23 SMC for clearing and grading standards.~~

- ~~A. Where practicable, natural grades and significant natural features found on-site shall be incorporated into the overall design of the project.~~
- ~~B. Existing significant individual trees and groups of trees should be preserved, where possible.~~
- ~~C. The disturbance of required open space areas should be minimized during development and restored prior to project completion. (Ord. 97-019 § 4, Exh. B)~~

18.22.045 Tree Retention and Native Vegetation Retention Standards.

A. Where reasonable and practicable, all development projects shall retain existing significant individual trees and groups of trees. See part (B) of this Section for native vegetation retention standards. Any significant trees shall be replaced according to the standards set forth in part C (3). Species of local and regional significance, particularly Garry Oaks and the Sequim cactus, shall permission for removal from the City Planning Director or designee.

B. The following native vegetation and impervious surface standards are encouraged for all projects

and preferred for PUD projects.

<u>Table 18.22.045: Native Vegetation and Impervious Surface Standards</u>		
<u>Proposed Use²</u>	<u>Minimum Native Vegetation Area</u>	<u>Maximum Impervious Surface³</u>
<u>Non-Multifamily Residential</u> <u>3.5-4.9 du/ac²</u>	<u>35%</u>	<u>30%</u>
<u>Non-Multifamily Residential</u> <u>5.0-6.9 du/ac²</u>	<u>20%</u>	<u>35%</u>
<u>Non-Multifamily Residential</u> <u>7.0-9.9 du/ac²</u>	<u>20%</u>	<u>40%</u>
<u>Non-Multifamily Residential</u> <u>≥10.0 du/ac²</u>	<u>20%</u>	<u>60%</u>
<u>Multi-Family^{1,2}</u>	<u>20%</u>	<u>70%</u>
<u>Commercial²</u>	<u>10%</u>	<u>70%</u>

¹ Multi-family projects are those projects containing more than four dwelling units attached in a single structure, regardless of ownership mechanism.

² Dwelling units per acre is based on gross density.

³ Impervious area includes all hard surfaces that impede infiltration of rainfall into the underlying soil profile. Many LID Techniques improve the ability of water to infiltrate into the soil. These techniques count against the impervious surface totals only to the extent indicated by Chapter 7 of the *LID Technical Guidance Manual for Puget Sound* (January 2005 or as amended).

C. Native Vegetation Areas.

1. Definition. Native vegetation includes native, undisturbed areas or rehabilitation of previously disturbed areas. Native vegetation shall consist of plants that are indigenous to the Pacific Northwest or near natives that are suitable for the Pacific Northwest climate. For the purposes of this chapter, native vegetation is defined by a tree density of no less than one tree per 400 square feet.

2. General Provisions.

- a. Trees to be retained or replanted shall be healthy and free of disease.
- b. Healthy, significant existing vegetation should be retained to the maximum extent possible. Healthy trees over twenty-four inches in diameter at d.b.h or that are over one hundred years of age shall be priority trees for preservation.
- c. Trees shall be retained in stands or clusters. A professional forester, arborist, or landscape architect shall prepare the vegetation management plan to ensure that retained vegetation is not susceptible to windthrow.
- d. Native vegetation may be accommodated within perimeter landscaping or other required landscaped areas.

- e. The minimum native vegetation retention may be decreased to 10 percent for non-residential uses (e.g., churches, schools, etc.) that are allowed in the underlying zone.
 - f. The calculation of the native vegetation retention area for public school sites shall be based upon the total acreage of the school site minus the areas set aside for playfields in the school site plan; provided that for the purposes of the calculation, such playfield areas shall not exceed 30 percent of the gross site area.
 - g. Critical areas and their buffers may be counted towards this standard so long as they contain existing native vegetation (e.g., a steep slope with Douglas fir may be counted while one with Himalayan blackberry may not). Critical areas and their buffers that will be counted towards native vegetation shall not have to comply with the replanting standards within this chapter. Land below an ordinary high water mark shall not be counted towards the required native vegetation. Dispersion of stormwater into critical areas is not permitted per Chapter 5, Volume V, of the *Stormwater Management Manual for Western Washington-2005* (or as amended).
 - h. Any soils disturbed through the site development process that are to be counted toward the native vegetation requirements shall be amended in accordance with the “Guidelines for Implementing Soil Quality and Depth” (BMP T5.13 in the *Stormwater Management Manual for Western Washington-2005* or as amended). The soil quality design guidelines listed above can be met by using one of the methods listed below:
 - 1. Leave undisturbed native vegetation and soil, and protect from compaction during construction.
 - 2. Amend existing site topsoil or subsoil either at default “preapproved” rates, or at custom calculated rates based on specifiers tests of the soil and amendment.
 - 3. Stockpile existing topsoil during grading, and replace it prior to planting. Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a default “pre-approved” rate or at a custom calculated rate.
 - 4. Import topsoil mix of sufficient organic content and depth to meet the requirements.

More than one method may be used on different portions of the same site. Soil that already meets the depth and organic matter quality standards, and is not compacted, does not need to be amended.
 - i. Trees preserved under the tree preservation requirements of this Chapter may be counted towards the native vegetation retention standards, so long as they meet the provisions of this chapter.
3. Replanting Requirements.
- a. If the site or lot has been previously cleared, then the minimum percentage of native vegetation shall be replanted to achieve the requirements of this section.
 - b. New trees that will be planted in native vegetation areas shall meet the following standards:
 - 1. Replacement deciduous and broad-leaf evergreen trees shall have a minimum 2” d.b.h. at planting. Replacement coniferous evergreen trees shall have a minimum height of 8’ at planting;
 - 2. Native vegetation areas shall be replanted with species indigenous to the Northwest or suitable for the Pacific Northwest climate; reforested areas shall be replanted with a minimum of 25% deciduous species and 30% coniferous species;
 - 3. Trees within the designated protected environmentally sensitive areas shall be replanted at a 2:1 ratio.

- c. Where unique site and building design requirements (e.g., certain industrial uses and public schools) preclude the retention of existing native vegetation to the percentages specified in Table 18.22.045, replacement and supplemental planting may be utilized. The replacement and supplemental plantings should be located in clusters or contiguous tracts and placed to maximize aesthetic, hydrologic, or habitat function and values.
- 4. Native Vegetation Guidelines. The following guidelines should be used with the applicant's design concept in order to meet the required standards outlined in Table 18.22.045.
 - a. Minimize changes to natural topography in effort to maintain pre-development flow path lengths in natural drainage patterns.
 - b. Maintain surface roughness to reduce flow velocities and encourage sheet flow on the lot by preserving native vegetation, forest litter and micro surface topography.
 - c. Amend disturbed soils to regain predevelopment stormwater storage capacity (See BMP T5.13 in the *Stormwater Management Manual for Western Washington-2005* or as amended).
 - d. Preserve native vegetation, forest litter and surface topography to the extent possible to more closely mimic natural hydrology.
 - e. Utilize the site inventory and analysis techniques to determine which portions of the site are best suited to leave native vegetation. Typically these are the most environmentally sensitive areas such as wetlands, steep slopes, floodplains, critical fish and wildlife habitat areas. In residential developments, up to 25 percent of the native vegetation specified in Table 18.22.045 may be incorporated into the individual lot design where strict covenants or other protection measures are put in place.
- 5. Permanent Protections. A permanent protective mechanism shall be legally established to ensure that the required native vegetation area is preserved and protected in perpetuity in a form that is acceptable to both the applicant and the city and filed with the County Auditor's office. Restrictions on the future use of the native vegetation area shall also be recorded on the face of the plat for subdivision applications. A permanent native vegetation area shall be established using one of the following mechanisms.
 - a. Placement in a separate non-building tract owned in common by all lots within the subdivision;
 - b. Covered by a protective easement or public or private land trust dedication;
 - c. Preserved through an appropriate permanent protective mechanism that provides the same level of permanent protection as subsection (1) of this section as determined by the approval authority.
- D. Clustering.
 - a. To achieve the goals of low impact development, residential lots shall be clustered within the designated development area of the site. Clustering is intended to preserve open space, reduce total impervious surface area, and minimize development impacts on critical areas and associated buffers (Title 18 SMC). Preservation of open space reduces potential stormwater runoff and associated impacts and provides area for dispersion, filtration and infiltration of stormwater.
 - b. The arrangement of clustered building lots shall be designed to avoid development forms commonly known as linear, straight-line or highway strip patterns.

18.22.050 Industrial use.

Industrial uses shall be subject to the following development standards:

A. Arc welding, acetylene torch cutting or similar processes shall be performed so as not to be visible at eye level from any adjacent properties.

B. The storage and handling of flammable liquids, liquefied petroleum, gases and explosives shall comply with rules and regulations falling under the jurisdiction of the fire marshal, the laws of the state and other local ordinances. Bulk storage of inflammable liquids below ground shall be located no closer to the property line than the greatest dimension (diameter, length, or height) of the tank consistent with the requirements of the Uniform Fire Code.

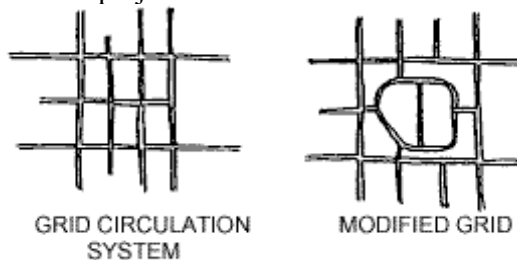
C. Provisions shall be made for necessary shielding or other preventative measures against interference occasioned by mechanical, electrical and nuclear equipment uses or processes with electrical apparatus in nearby buildings, or land uses.

D. Liquid and solid wastes, and the storage of animal or vegetable waste that attract insects or rodents or otherwise creates a health hazard shall be prohibited. Outside storage of waste products shall be screened, at eye-level, from view from adjacent properties. (Ord. 97-019 § 4, Exh. B)

18.22.060 Multifamily residential.

The following multifamily development standards are ~~intended to provide~~ to guidance for establish requirements which shall be met to provide ~~ment a~~ better integration of multifamily residences into the community consistent with the requirements of Comprehensive Plan policies LUP-11 through 16, and HUP 7 and 8. A. Orientation. Multifamily developments shall be designed to orient to public or private streets and to provide pedestrian and vehicular connections to existing nearby neighborhoods. The following standards shall be considered:

1. A modified street grid system where all buildings in a project front on an internal street or other access shall be developed. Where no public streets exist, a modified grid street system shall be created within the project.



2. Each building shall be provided with direct pedestrian access from a street fronting the building and from established parking areas to the multifamily dwellings and to the existing neighborhoods.

3. Where site and soil conditions make LID a feasible option, as determined by the City Engineer, the use of LID best management practices (BMPs) shall be required. LID BMPs shall be designed in accordance with the LID Technical Guidance Manual for Puget Sound (current edition).

B. Off-Street Parking. Impacts associated with multifamily dwellings can be reduced by providing adequate on-site parking and by designing and locating parking lots, carports, and garages to support the residential qualities of the neighborhood consistent with Comprehensive Plan Policy LUP 21. The following off-street parking standards shall be considered:

1. Parking areas shall be located behind or under buildings where practicable, and access shall be provided to such parking areas from alley-type driveways. If street access to parking areas is necessary, the number of access points shall be limited.

a. The number of driveways and curb cuts shall be minimized.

b. Driveways shall be shared (where possible) within a development.

2. Large parking areas shall be divided into smaller areas separated by buildings or landscaping.

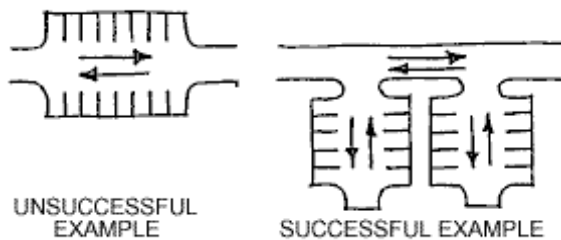
3. Parking shall be configured to be less visible from surrounding streets.

4. Driveways and parking areas shall include landscaping and/or berming.

5. Parking areas shall be screened when abutting single-family residences or zones, with

landscaping or fencing.

6. Parking lots adjacent to street frontage shall be limited to 30 percent of the street frontage.
7. Parking aisles shall be separated from site circulation routes.

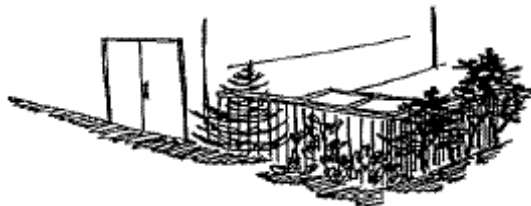


8. Parking lots shall be designed to be in conformance with ADA (Americans with Disabilities Act) regulations.

9. LID BMPs shall be used in parking lot design where site and soil conditions make LID feasible, as determined by the City Engineer. LID BMPs shall be designed and constructed in accordance with the LID Technical Guidance Manual for Puget Sound (current edition).

C. Resident Services. New development and redevelopment shall have adequate provisions for residential services including mailboxes, garbage and recycling pickup, transit stops, and walkways and parking area lighting as per Comprehensive Plan Policy LUP 25. The following resident service standards shall be considered:

1. Adequate safe pedestrian walkways shall be established to residential services.
2. Street lighting shall be provided along walkways adjacent to and within the multifamily development. Lighting shall minimize glare, and shall be downward facing and/or shielded.
3. Security lighting shall be provided in parking and play areas.
4. Lighting shall be directed away from neighboring properties to minimize glare.
5. Garbage, maintenance and recycling facilities should be screened.



6. Pedestrian access to nearby transit stops shall be provided along public rights-of-way.
7. Pedestrian connections to adjacent development shall be provided, where practicable, in public rights-of-way, or along designated trail corridors.
8. Pedestrian walkways shall be designed to be in conformance with ADA (Americans with Disabilities Act) regulations.

D. Open Space and Recreation. Usable open space and recreation areas within developments shall be required within multifamily residential developments consistent with Comprehensive Plan Policy OSR 13. The following open space and recreation standards shall be considered:

1. For individual projects less than five units which are not part of a larger development plan, open space may be provided through the establishment of individual yards for each unit. This shall include as applicable duplexes, triplexes and fourplexes.
2. Where a multifamily residential project consists of a total of five or more dwelling units, in any configuration, shared or common usable open space shall be provided in addition to any other open spaces or protected areas. Shared or common usable open spaces shall include landscaped areas and active or passive recreation opportunities for the residents. Projects located a distance of one quarter mile or less from an existing neighborhood or regional park may contribute impact fees in lieu of providing active or passive recreation facilities.

3. Minimum Area Required. Each multifamily project comprised of five or more dwelling units shall provide a minimum of 200 square feet of usable open space for each dwelling unit in the project. A portion of the usable open space may be required to provide for active recreational uses, as described in subsection (D)(4) of this section.

4. Play Space for Children. Multifamily residential projects comprised of five or more dwelling units that are anticipated by their type and anticipated residency to accommodate families shall provide a safe play space for children. Projects that are established solely for the occupancy of adults shall not be required to establish play spaces. Such uses may be congregate care facilities, senior only (over 55) housing developments, and adults only developments, as permitted by law. The required play space shall address the following standards:

a. Play spaces shall include play equipment which is manufactured and installed in conformance with the safety standards of the American Play Equipment Industry, or other adopted standards.

b. Play equipment shall not be located on a slope greater than four percent in any direction.

c. Play spaces shall not include driveways, parking areas, required landscaping areas or porches, balconies or overhangs.

d. Play spaces may be established within side and rear yard setbacks, excepting that no play space shall be located within 10 feet of any road, driveway or alleyway, parking area, or adjacent single-family resident or single-family residential zone without the provision of fences or buffers.

e. To maximize the personal safety of children resident in the development, play spaces shall be located so as to provide maximum visibility from surrounding multifamily dwelling units and be connected by pedestrian walkways and lighted.

f. Play space should be adequately sized and equipped to be roughly proportional to the anticipated recreational impact.

5. The provision of usable open space, play spaces, and/or recreational spaces within a multifamily development of five or more units may be phased concurrent with the approval of a phasing plan consistent with the requirements of this code; provided, that each phase shall include usable open space and playspaces (if required) established in proportion to the size and impacts of each phase.

E. Modulation of Building Facades, Staggering Entries, and Roofing. Buildings within a project shall have a common design theme that takes into account the scale and massing of existing adjacent development scale and style. The following design standards shall be considered:

1. Roof lines should provide visual interest and variety, by including features such as dormers, steps in the roof plane, chimneys, gables and other roof line modifications.

2. Building materials should be durable and easily maintained.

3. Entries to multifamily buildings shall be well lighted, easily identifiable and meet ADA requirements for accessibility.

F. Landscaping. Landscaping within a project shall have a common design theme that takes into account the existing scale and style or landscaping found in surrounding development patterns. The following landscaping standards shall be considered:

1. Multifamily residential developments shall include usable open space and landscaping.

2. Landscaping should separate buildings from pavement or walkways.

3. Street trees shall be provided along public streets and rights-of-way.

4. Landscaping should be easily maintained after the initial growth period. A maintenance plan to ensure the successful establishment and maintenance of landscaping may be required.

5. Landscaping for multifamily residential developments shall meet all other applicable landscaping requirements contained in this title. (Ord. 97-019 § 4, Exh. B)

18.22.070 Commercial uses.

The following commercial development standards are provided to establish requirements which shall be met to provide a ~~The following commercial development standards are intended to provide guidance for the establishment of commercial uses, and to~~ better integrated commercial development into the

community consistent with Comprehensive Plan Policies LUP-11 through 16.

A. Off-Street Parking. All off-street parking standards of this title shall be met.

B. Site Planning. Commercial development shall be designed to accommodate safe ingress and egress, pedestrian and vehicular circulation, and visibility of the commercial uses. The following standards shall be considered:

1. Adequate stacking or vehicle queuing room at driveways and street intersections shall be provided, based on engineered traffic studies and calculations.
2. Where practicable, shared access and circulation should be provided to minimize vehicular curb cuts.
3. Commercial developments should inhibit the use of on-site circulation and parking areas as “cut-throughs.”
4. Buildings should be separated from pavement with landscaping and/or walkways.
5. Landscaped setbacks between roads and parking shall be provided.
6. Where practicable, service vehicle accesses and parking areas should be separated from customer parking and circulation.
7. Outside storage shall be screened from view from public roads and neighboring properties.
8. Where practicable, established trees shall be preserved and incorporated into site landscaping.
9. Off-site traffic controls, devices, or improvements, including traffic lights, intersection improvements, and/or turning lanes shall be installed, as required by the city engineer.
10. Parking areas shall be designed to be in conformance with all applicable ADA (Americans with Disabilities Act) regulations.

11. LID BMPs shall be used where site and soil conditions exist and are feasible, as determined by the City Engineer. LID BMPs shall be designed in accordance with the *LID Technical Guidance Manual for Puget Sound* (current edition).

C. Public Services. Public services required for commercial development include garbage and recycling pick-up, transit stops, pedestrian circulation and walkways, and street and area lighting. The following commercial public service standards shall be considered:

1. Adequate safe pedestrian walkways shall be established to commercial uses.
2. Street lighting shall be provided along walkways adjacent to and within the commercial development. Lighting shall not create glare, and shall be downward facing and/or shielded.
3. Security lighting shall be provided in parking and service areas.
4. Lighting shall be directed away from neighboring properties.
5. Garbage, recycling, and maintenance facilities shall be screened.
6. Pedestrian access to nearby transit stops shall be provided.
7. Pedestrian connections to adjacent developments shall be provided.
8. Pedestrian walkways shall be designed to be in conformance with all applicable ADA (Americans with Disabilities Act) regulations. (Ord. 97-019 § 4, Exh. B)

18.22.075 Mini-storage and self storage facilities.

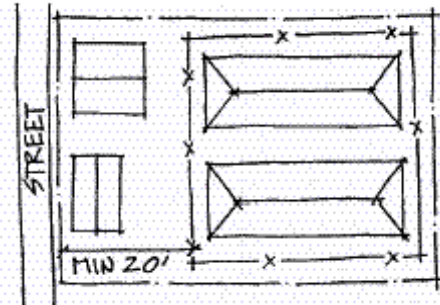
The following mini-storage development standards are provided to establish requirements which shall be met to provide. The following development standards are intended to provide additional guidance for the establishment of mini-storage and self storage facilities when located within a commercial zoning district, and to better integrate such development into the community consistent with Comprehensive Plan Policies LUP-11 through 16.

A. All of the development standards for commercial uses shall apply to mini-storage and self storage facilities when they are located within a commercial district.

B. Site Planning. Mini-storage and self service storage facilities shall be integrated into the commercial district within which they are located. The following standards shall apply:

1. Where possible offices, retail storefronts, and other appropriate mixed uses (residential on upper levels) should be established adjacent to developed street frontages.

2. Sidewalks and other appropriate pedestrian access improvement shall be provided along street rights-of-way adjacent to the proposed project.
3. Off-site views of loading and/or access doors to the storage unit facilities shall be minimized.
4. Security fencing shall not be located within 20 feet of the primary street frontage. Security fencing should be located behind street-fronting buildings.



5. Outside storage of recreational vehicles and boats shall be screened from view from public roads and neighboring properties.

6. LID BMPs, such as pervious pavement and bioretention swales, shall be used where site and soil conditions are feasible, as determined by the City Engineer. LID facilities shall be designed and constructed in accordance with the LID Technical Guidance Manual for Puget Sound (current edition).

C. Use and Operation. Mini-storage and self service storage facilities located adjacent to residential districts should establish hours of operation consistent with adjacent, permitted businesses. Hours of operation should not extend beyond 10:00 p.m. nor occur prior to 7:00 a.m. (Ord. 98-004 § 2(B))

18.22.080 Mixed use.

Mixed use developments that are compatible with existing land uses, encourage pedestrian access, and provide an efficient use of land shall be encouraged consistent with Comprehensive Plan Policy LUP 16. Mixed use developments include those developments where different uses are proposed on the same parcel. Mixed use developments may be located within any zoning district, and shall be subject to the following development standards:

A. Mixed use development shall be established through the approval of an application for planned unit development or binding site plan that specifies uses, lot divisions and infrastructure improvements, or a subdivision application consistent with the requirements of the PUD or binding site plan and subdivision sections of this code.

B. Multifamily residential uses located within a mixed use development shall be established consistent with the above referenced development standards adopted for multifamily residential development.

C. Commercial land uses located within a mixed use development shall be established consistent with the standards for commercial development established by this section.

D. Industrial land uses located within a mixed use development shall be established consistent with the standards for industrial development established by this section.

E. Proposed dissimilar land uses located within a mixed use project shall ensure appropriate separation and/or buffering between incompatible uses.

F. Signage. A signage master plan shall be prepared for each proposed mixed use development consistent with the standards contained within Chapter 18.58 SMC.

1. Impacts associated with the adverse effect of lighted signage on adjacent dissimilar uses contained within a mixed use project shall be addressed.

2. A unified and coordinated sign scheme shall be created within each proposed mixed use development.

G. Shared Services. New development and redevelopment within a mixed use development shall provide adequate provisions for services including mailboxes, garbage and recycling pickup, transit stops,

and walkways and parking area lighting consistent with Comprehensive Plan Policy LUP 25. The following shared service standards shall be considered:

1. Adequate safe pedestrian walkways should be established to shared services.
2. Street lighting shall be provided along walkways adjacent to and within the multifamily development. Lighting shall minimize glare, and shall be downward facing and/or shielded.
3. Security lighting shall be provided in parking or public areas.
4. Lighting shall be directed away from neighboring properties.
5. Garbage, maintenance and recycling facilities shall be screened and these services shared between uses when feasible.
6. Pedestrian access to nearby transit stops shall be provided along public rights-of-way.
7. Pedestrian connections to adjacent properties shall be provided where practicable.

H. Landscaping. Mixed use developments should provide landscaping consistent with the landscaping requirements for the type of development proposed. Landscaping within a project shall have a common design theme which takes into account existing development and compatibility of uses. The following landscaping standards shall be considered:

1. Landscaping shall separate buildings from pavement or walkways.
2. Street trees shall be provided along public streets and rights-of-way.
3. Landscaping should be easily maintained after the initial growth period. A maintenance plan to ensure the successful establishment and maintenance of landscaping may be required.
4. Landscaping for mixed use developments shall meet all other applicable landscaping requirements contained in this title. (Ord. 97-019 § 4, Exh. B)

I. LID BMPs shall be used where site and soil conditions exist and are feasible, as determined by the City Engineer. LID BMPs shall be designed in accordance with the *LID Technical Guidance Manual for Puget Sound* (current edition).

Chapter 18.24

DESIGN STANDARDS DRAFT

Sections:

18.24.010	Purpose.
18.24.020	Intent.
18.24.030	Utilization.
18.24.031	Design Approval Required.
18.24.032	Design Review Application.
18.24.033	Design Review Procedure.
18.24.034	Administrative Approval.
18.24.035	Design Review Board Recommendation.
18.24.036	Design Review Approval Expiration.
18.24.037	Criteria For Approval – Required Findings.
18.24.038	Appeals.
18.24.039	Modifications.
18.24.040	Definitions.
18.24.050	Facades, Exterior Walls and Entryways.
18.24.060	Back and Side Facades.
18.24.070	Smaller Structures in Regional Centers.
18.24.075	Site Planning and Compatibility.
18.24.080	Detail Features.
18.24.090	Roofs.
18.24.100	Materials.
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18.24.120	Colors.
18.24.130	Landscaping and Buffering.
18.24.140	Entrances.
18.24.150	Fences.
18.24.160	Environmentally Conscious Development.
18.24.170	Parking Lot Design and Orientation.
18.24.180	Lighting and Glare.
18.24.190	Pedestrian Flows.
18.24.200	Outdoor Storage, Trash Collection, Recycling and Loading Areas.
18.24.210	Central Features and Community Spaces.
18.24.220	Multi-building and Multi-family Projects.
18.24.230	Town Center Sub-area.
18.24.240	Transportation Consistency Requirements.
18.24.250	Other Requirements.

18.24.032 Design review application.

Pre-Application:

- A. An applicant must request a pre-application meeting with city staff. This meeting allows an applicant an opportunity for early project review before formal submittal. The pre-application review does not bind the city in any way, but rather is offered as a convenience to the applicant. No fee shall be assessed for a design pre-application meeting. Pre-application does

not vest the application. Applicants may also schedule meetings with city staff prior to the pre-application for early project consultation. Request for design review pre-application meetings should include the following:

1. Vicinity map showing site location in relation to surrounding sites and development;
2. A sketch or drawing of the site showing its approximate configuration and dimensions;
3. A sketch or drawing of the site showing natural site conditions including topographic information and existing vegetation. Photographs are encouraged;
4. Conceptual drawings or sketches of proposed buildings.

Application:

B. Application for design review shall be on application forms provided by the city. The city shall also furnish applicants with guidelines and standards to assist in design. All applications shall be submitted to the City Planning Department, who shall conduct an initial assessment for completeness and code compliance prior to review routing to design review board members.

C. A complete design review application shall include the following:

1. Site Layout. A plan, drawn to scale no smaller than one inch equals 30 feet showing location and size of all structures, critical areas, required buffer areas, landscape areas, open spaces, common areas or plazas, walkways, preliminary stormwater retention/detention facilities, and parking lot layout and vehicle circulation.
2. Vegetation Plan. A plan which accurately identifies the species, size and location of all significant vegetation within the property subject to the application.
3. Tree Retention Plan. A landscape plan showing the species, size and location of all significant (SMC 17.28.030) trees and natural-native vegetation to be retained on the property.
4. Low Impact Development (LID). A plan showing all proposed LID best management practices to be used in the site design, where applicable (SMC 18.22.035). The plan shall identify and describe the type of LID technique(s) being used and applicable calculations (e.g. size, capacity, etc.).
54. Preliminary Site Section Drawings. Section drawings which illustrate existing and proposed grades.
65. Preliminary Grading Plan. An accurate topographic map of the property, delineating contours, (existing and proposed) at no greater than five-foot intervals. The plan shall indicate all proposed cuts, fills, and retaining wall heights and include areas of disturbance necessary to construct all retaining walls, structures and impervious surfaces.
76. Preliminary Utilities Plan. A utilities plan showing the location and type of any utilities proposed in critical areas, critical area buffers and natural vegetation retention areas.

- | 87. Elevation Drawings. Complete elevation drawings of all buildings showing dimensions and proposed materials including roofing, siding, windows and trim. Drawings shall include conceptual trim and cornice design and roof pitch. If landscaping is proposed to soften or mitigate architectural modulation or details, additional elevation drawings showing proposed landscaping shall be provided.
- | 98. Equipment Screening. A description of how all mechanical and utility equipment will be screened.
- | 109. Color and Material Palette. The proposed schematic color and material palette for exterior siding, trim, cornice, windows and roofing of all proposed structures.
- | 110. Fencing. The location and description of any proposed fencing.
- | 121. Lighting and Signage. A photometric plan identifying location and height of proposed parking lot, pedestrian and/or building security light structures and poles. Sign type and location shall be identified. A separate City of Sequim sign application will be required for additional sign information.
- | 132. Accessories. The location of all outdoor furniture, trash receptacles, recycling areas, bicycle racks and other accessories.
- | 143. Applications for design review shall be accompanied by a fee as established by the city council.

D. Applicants pursuing two or more land use permits on a single project may consolidate the review process in conformance with Section 20.01.050, Sequim Municipal Code.

18.24.040 Definitions.

“ Low Impact Development (LID) means a stormwater management strategy that emphasizes conservation and use of existing features integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns in residential, commercial, and industrial settings.”

18.24.130 Landscaping and buffering.

A. Guideline: Commercial, mixed use and multi-family development should ensure that the parking, lighting, circulation and landscaping aspects are well designed with regard to safety, efficiency and convenience for vehicles, bicycles, pedestrians and transit, both within the development and to and from surrounding areas. Landscape and buffering should contribute to visual quality and continuity within and between developments, provide screening and mitigation of potential conflicts between activity areas and site elements, enhance outdoor spaces, reduce erosion and stormwater runoff and mitigate air pollution.

Landscaping that incorporates low impact development strategies for stormwater management should serve to meet the requirements of the city of Sequim’s currently adopted

stormwater management plan.² Low impact development stormwater management facilities shall be designed and constructed in accordance with the use of the *LID Technical Guidance Manual for Puget Sound* (current edition).

Due to Sequim's growing agri-lavender business, developers are strongly encouraged to incorporate lavender plants into their landscape design plan (especially for perimeter landscape areas). Evergreen varieties such as Grosso or Hidcote Giant or alternatives such as rosemary, which have attractive foliage when not in bloom, are recommended species. If proper conditions exist, the addition of Garry oak trees into the landscaping is encouraged.

For large structures (20,000 square feet or greater) the rear or sides of buildings often present an unattractive view of blank walls, loading areas, storage areas, HVAC units, garbage receptacles, and other such features. Architectural and landscaping features should mitigate these impacts.

B. Standards:

1. Landscape areas shall include all areas on the site that are not covered by buildings, structures, paving or impervious surface. The selection and location of turf, trees, ground cover (including shrubs, grasses, perennials, flowerbeds and slope retention), pedestrian paving and other landscaping elements shall be used to prevent erosion.
 - a. Landscape design plans shall complement existing or proposed landscaping within a development and shall enhance the personal scale of a development by clearly defining pathways, entrance areas, plazas or public gathering spaces, parking areas, and access roadways.
 - b. Landscape design plans shall mitigate the impact to neighboring properties. The rear elevations of buildings, loading docks, and refuse collection areas must also be addressed in the landscape design plan. [It is required that rear elevations adjacent to noncommercial-zoned parcels will be adequately screened within seven (7) years of occupancy of the retail space.]
 - c. Landscape design plans shall incorporate a mix of indigenous and native plants that are hardy and drought tolerant and shall include a minimum of 40 percent evergreen plantings (trees, shrubs, groundcovers, ornamental grasses, and evergreen herbs). Permanently installed irrigation systems are required.
 - d. For large structures (20,000 square feet or greater), perimeter landscape buffer planting areas shall be a minimum of 10 feet in depth from the edge of walkways, curbs or property lines, along all sides of the property. Parcels smaller than 30 acres shall have a perimeter landscape buffer depth of 10 feet. Parcels 30 to less than 50 acres shall have a perimeter landscape buffer depth of 13 feet. Parcels 50 acres or greater shall have a perimeter landscape buffer depth of 15 feet.
 - e. For large structures (20,000 square feet or greater) parking lots with more than 50 parking spaces shall have curbed planting areas. Planting areas shall be placed at each end of a parking row. No parking row shall contain 18 contiguous or abutting parking spaces without a curbed planting area.
 - f. Parking lots associated with structures under 20,000 square feet shall have curbed planting areas dividing the parking spaces as required for in Section 18.24.180, Parking Lot Design and Orientation.
 - g. Landscape design plans shall also address a variety of landscape lighting elements utilized both for safety and aesthetics.

- h. Any landscape element that dies or is otherwise removed, shall be promptly replaced with the same, if not similar to, height or texture element as originally intended.
 - i. Off-site access to pedestrian and bicycle facility improvements may be required in order to comply with the transportation element of the comprehensive plan and the Sequim Municipal Code.
 - j. Where possible, pedestrians and vehicles shall be separated through provision of a walkway. Where complete separation of pedestrians and vehicles is not feasible, hazards shall be minimized by using landscaping, bollards, special paving, lighting and other means to clearly delineate pedestrian areas.
 - k. For large structures (20,000 square feet or greater) landscaped parkways around parking lot perimeters shall be consistent with minimum setback requirements. Trees may be spaced irregularly in informal groupings or be uniformly spaced, as consistent with larger overall planting patterns and organization. Perimeter landscaping along a street and within the public right-of-way shall utilize the adopted city of Sequim Streetscape Manual³ for community-wide consistency.
 - l. Future maintenance shall be in accordance with accepted maintenance practices.⁴
 - m. All landscaping shall respect the existing natural topography.
 - n. Secondary design elements such as low walls, planter boxes, stairs or plaza surfaces that incorporate materials used on the building's exterior shall be incorporated into the landscape design around the building's perimeter to visually anchor and transition the building to the site.
 - o. Construction, such as but not limited to, buildings, structures, paving or impervious surface, shall not take place within the drip line of existing Garry oak trees.
 - p. The protection of existing Garry oak trees during construction is mandatory unless deemed to be sick, dying or dead by an ISA-certified arborist.
 - q. Topping of trees shall not be allowed unless necessary for safety reasons as certified by an ISA-certified arborist.
 - r. Encourage the use of vines and shrubs along blank walls.
 - s. The rear or sides of buildings often present an unattractive view of blank walls, loading areas, storage areas, HVAC units, garbage receptacles, and other such features. Architectural and landscaping features shall mitigate these impacts.
 - t. Landscape Design Plans shall not allow for any vegetation listed on the County's noxious plant list.
2. Whenever possible, the landscape design shall provide open spaces that preserve views and enhance the penetration of sunlight into buildings and common areas. Regional vistas and landmarks shall be maintained.

18.24.160 Environmentally conscious development.

A. Guideline: When practical and possible, the use of "green" materials in construction is strongly encouraged. Alternative forms of energy, such as but not limited to, solar or wind power, along with skylights, garden roofs and shared parking are also strongly considered. Low impact development techniques are also recommended for stormwater conveyance and treatment.

18.24.170 Parking lot design and orientation.

A. Guideline: Off-street parking for commercial and mixed use buildings should be designed to minimize visual impact. Parking areas should provide safe and efficient ingress and egress

for vehicles and public transit. Parking lots should be configured and designed to reduce the overall mass of paved surfaces, see Figure 3.

Parking lots should be designed to avoid erosion damage to grading and surrounding landscaping. Parking lot layout should respect the existing natural site features, minimizing site disturbance and maximizing opportunities for creative stormwater management techniques. Whenever possible, permeable paving systems should be evaluated and utilized (especially for employee parking areas). To reduce impervious services, one-way drive aisles should be encouraged.

Parking lots should incorporate methods for stormwater management utilizing low impact development (LID) techniques.¹ These include:

1. End-of-island bioretention cell(s) with underdrain(s) and landscaping;
2. Bioretention cells or biofiltration swales located around the parking perimeter, (see Figure 10);
3. Breached curb drainage inlets (or curb cuts) in the end-of-island bioretention cells and bioretention strips to collect runoff;
4. Bioretention cells can be installed between lines of parking stalls to increase the total treatment surface area of these systems.

Projects that combine commercial with residential units may use “shared parking” in order to reduce their parking stall requirements. These mixed-use projects should consider locating the buildings on the front setback line and the parking lots and garages behind the buildings.

Wherever possible, off-street parking for commercial, mixed use, industrial, and multi-family projects shall utilize a small-lot design approach; designs configured to reduce the visual effect of the overall paved surface; a maximum of six (6) spaces in a row or twelve (12) spaces abutting each other without a curbed planting area dividing the spaces.

B. Standards:

1. Large-surface parking lots (50 or more spaces) shall be visually and functionally segmented into several smaller lots.
2. Parking lot design must include detailed information on non-motorized and pedestrian access to and through the development. Demarcation shall be required by utilizing a combination of: (a) change in paving surface materials, (b) landscaping, or (c) safety and directional lighting.

Figure 11

3. All required internal walkways must be located and constructed as an integral part of existing walkways and must coordinate with the city's non-motorized trail plan, if applicable.
4. For large structures (20,000 square feet or greater) setbacks for parking lot layout shall be provided at a minimum of 10 feet from any public right-of-way (except for alleys). This setback or buffer area between the street or access road and the parking lot shall always include trees, drought-resistant natural groundcovers, and other native landscape materials.
5. No parking row shall contain 12 contiguous or abutting parking spaces without a curbed planting area or bioretention cell. These areas shall include trees to a minimum height and diameter as specified in SMC 18.24.130 and these areas shall contribute to small-scale control of stormwater runoff.
6. Traffic calming techniques shall be utilized for pedestrian safety.⁵
7. Where applicable, provide adequate and easily accessible cart corrals. Landscaping shall be provided adjacent to these cart corrals to off-set visual impacts.
8. If the landscape plan incorporates the retention of significant trees above the requirements of SMC 18.24.130, the city may approve a reduction of up to 10 percent of the required number of parking spaces if adequate parking is available for entire site build-out.
9. Except for properties located in the Towncenter subarea, the minimum number of parking spaces required is one per 400 gross square feet, and the maximum number is one per 250 gross square feet.
10. No more than 50 percent of required parking may be located forward of the front façade of a building.
11. Parking lots and garages between and behind buildings shall have well-signed site and building ingress and egress for pedestrian cueing and movement.
12. Pervious pavement applications (grass-crete, etc.) may be utilized in conformance with acceptable application standards.

Sequim Municipal Code

Chapter 18.40 PLANNED UNIT DEVELOPMENTS

Sections:

- 18.40.010 Intent and authority.
- 18.40.012 Purpose.
- 18.40.015 Approved as overlay districts.
- 18.40.020 Permitted.
- 18.40.030 Application of regulation.
- 18.40.040 Affordable housing.
- 18.40.050 Preapplication required.
- 18.40.060 Application requirements.
- 18.40.065 LID requirements.
- 18.40.067 Native vegetation and impervious surface standards.
- 18.40.070 Procedure – Fees.
- 18.40.080 Adequacy – Distribution of plans.
- 18.40.090 Procedure – Notice of hearing.
- 18.40.100 Technical review.
- 18.40.110 Review criteria.
- 18.40.120 Property use and development agreement (PUDA) – Required.
- 18.40.130 Protective covenants.
- 18.40.140 Minimum development standards.
- 18.40.150 Amendments.

18.40.010 Intent and authority.

It is the intent of this chapter to conditionally permit, where appropriate, residential and/or mixed use projects which better implement the goals of the comprehensive plan than might be achieved otherwise through strict adherence to the standards of this code, while avoiding significant adverse influences upon adjacent properties. The PUD process is intended to provide flexibility in the application of certain zoning regulations and thereby promote a harmonious variety of uses within each PUD, realizing economies of shared services and facilities, and creating a safe, aesthetic and healthful living and shopping environment. This chapter is adopted in furtherance of state law and the comprehensive plan of the city. These regulations are intended to facilitate a fair and predictable process for the development of land in a manner that is sustainable and contributes to the character of the community. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.012 Purpose.

The purpose of a planned unit development is to encourage an integrated, creative and flexible approach to the development of land, which provides for the public welfare, preserves additional undeveloped lands not protected by existing environmental regulations, and allows for the establishment of uses not usually allowed within the same zoning district to be permitted; provided, that design criteria which address the incompatibilities have been successfully applied. Planned unit developments promote “sustainable” site planning, which minimizes adverse

environmental impacts while accommodating the long-term needs of the community. Planned unit developments that are sustainable incorporate the following design principles:

A. Site design which follows existing topography and respects and preserves natural systems and historic features.

B. Site design which respects environmental conditions of the property and preserves sensitive environmental features beyond the requirements of city and state regulations.

C. Site design which incorporates low impact development (LID) best management practices (BMPs) whenever site and soil conditions make LID feasible, as determined by the City Engineer.

D. Site design which considers the public welfare and provides appropriate community amenities.

E. Site design which accommodates flexibility and the potential for adaptive reuse and density changes without compromising the intent of the project.

F. Site design which ensures the reduction of energy and resource use and provides utilities and services more efficiently than conventional development patterns.

G. Site design which supports a diverse and sustainable population and economy.

H. Site design which allows for the integration of affordable housing. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.015 Approved as overlay districts.

Planned unit developments, when approved consistent with the criteria of this chapter, shall be noted on the official zoning map as a PUD overlay. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.020 Permitted.

A planned unit development, when approved in accordance with this chapter, must be accompanied by either an application for a minor or major subdivision or binding site plan approval. All residential planned unit developments that propose individual lots which will be conveyable shall be accompanied by a concurrent application for a minor or major subdivision. Commercial developments may be accompanied by either a major subdivision or binding site plan application. Mixed use developments that propose a combination of residential and/or commercial uses shall submit a major subdivision application. Residential planned unit developments that do not propose individual, conveyable lots (condominiums, manufactured home parks, etc.) shall submit a binding site plan application. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.030 Application of regulation.

A. Planned unit development overlays may be applied for in all zoning districts located within the city. When planned unit developments are proposed in commercial and mixed use zones, stand-alone residential development will be allowed but is limited to 30 percent of the entire parcel. Residential development located above ground-floor commercial is not considered stand-alone.

B. The following provisions shall apply to applications for residential planned unit developments (no planned unit development will be allowed on a parcel of land under five acres unless the development provides affordable housing):

1. Up to 20 percent of the land area within a PUD may be proposed to contain nonresidential uses conditionally allowed in the underlying zoning district, or nonresidential uses allowed in the C-I(NC) district consistent with the use designation contained within Chapter 18.16 SMC, and with the criteria found in SMC 18.40.140. Approval of a PUD, which specifically requests conditional uses or specific uses permitted within the C-I(NC), shall not require an additional conditional use approval. Subsection A of this section does not apply.
2. The lot size and setback requirements of the underlying district are as follows: no minimum lot size or maximum lot coverage; the front yard setback from the right-of-way is 10 feet plus a 20-foot garage setback; a 15-foot rear yard setback and a 10-foot side yard setback for end units. No higher density, multifamily, or commercial uses on the exterior boundary unless that use matches the zoning of the adjoining land. Setbacks from exterior boundaries shall be 30 feet including an eight foot buffer zone created on the exterior boundary as per code (SMC 18.22.020(A)). No variance in height or road standards shall be allowed.
3. The gross density provisions of the subject zoning district may be transferred, aggregated, increased by up to 25 percent and/or allocated within those planned unit developments that propose preservation in open space of no less than 20 percent of the total land area, as follows:
 - a. To provide open space for the purpose of active or passive recreation, consistent with the open space criteria of this code (SMC 18.40.140(F)); and/or
 - b. To more fully preserve critical areas or unique natural features with greater buffer areas beyond that required by the code; and/or
 - c. To preserve historic and cultural resources, including but not limited to small working farms, barns and agricultural buildings, small-scale urban agricultural, and historic buildings; and/or
 - d. To provide for on- or off-site public services such as public stormwater facilities, parks, schools, government buildings, and public urban spaces such as plazas, streetscape improvements, walking/bike trail connections, and civic or cultural centers.
4. Land that is undeveloped for the purposes of buffering the project, providing public rights-of-way and/or protecting critical areas and their buffers, as required by code, and which does not include active or passive recreational amenities shall not be included in the 20 percent open space calculation. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.040 Affordable housing.

Integration of qualified affordable housing units within residential planned unit developments will be allowed additional bonuses and incentives.

A. A planned unit development less than five acres must include affordable housing. Twenty percent of the lots allowed in the PUD must be affordable housing lots. For each affordable housing unit, a bonus of one standard lot will be allowed.

B. A planned unit development equal to or greater than five acres may reduce the open space requirement (SMC 18.40.030(B)(3)) by one-half allowing one-tenth of one acre per affordable housing unit created.

C. A planned unit development equal to or greater than five acres providing qualified affordable housing will be allowed one additional standard unit per qualified affordable housing

unit. Affordable housing shall not exceed 20 percent of the base density allowed in the underlying zone.

D. A description of how the proposed affordable housing component, if applicable, will meet the criteria for qualified affordable housing.

E. A written statement from the Clallam County housing authority indicating what level of average median income of the qualified affordable housing component will be applied and describing the “qualified household” eligible for the affordable housing. Also, the maximum sales price for the sale of the house, if the developer elects to build the housing rather than sell the lots to an existing, bona fide nonprofit affordable housing organization whose primary purpose is providing affordable housing which housing organization is acceptable to the city of Sequim. If the developer decides to sell the property to an affordable housing organization as described herein, the sales price shall be no more than the cost of improving the affordable lots (including hard and soft costs but not land cost) plus 10 percent. If the developer elects to sell the lots to an existing, bona fide nonprofit affordable housing organization whose primary purpose is providing affordable housing, which housing organization shall provide for compliance with this section and shall have deed restrictions at least as restrictive as subsection J of this section.

F. Affordable housing units must be integrated within the entire development and not be segregated.

G. For PUDs incorporating qualified affordable housing, a design review meeting will be required to ensure the consistency of architectural style and compatibility with the adjacent structures and land uses.

H. The covenants or alternative mechanism should establish standards for such items as architectural character, allowable construction materials and structural types, recommended landscaping, allowable signs, setbacks, and other items; provided, that no standards shall be less restrictive than the standards specified in the applicable PUD and that all garages be no smaller than 20 feet by 20 feet; except, that where other units in the PUD or subdivision have other off-street parking provisions, such affordable housing shall utilize the same offstreet parking provisions as such other units in the PUD or subdivision. The exterior design, appearance and parking solutions (including garages) must be compatible with the rest of the development except for the sizes of the houses. All single-family affordable units will have a minimum of 1,000 square feet of living space not including garages, patios, sheds or decks. This 1,000 square-foot minimum does not apply to apartment complexes with buildings encompassing more than four units.

I. All requirements for affordable housing must be submitted and approved prior to or as part of preliminary plat approval including, but not limited to, the covenants, conditions and restrictions, the deed restrictions and the proposed disposition of the affordable housing units.

J. If the developer decides to build the house, the developer must sell the house to a qualified household for no more than the price described herein. In addition, the developer must place a deed restriction in the deed conveying the property to the qualified household a restriction running with the land that from the time of the first conveyance, any subsequent conveyance shall have the following limitation: any moneys received by the qualified household seller in excess of the actual reduction of the principal of the mortgage and the down payment and payments for home improvements for the first five years after the purchase by the qualified household shall revert to and belong to the city of Sequim. During the subsequent five years, 20 percent of the excess funds received shall belong to the qualified household seller for each year

after the first five years and the balance shall revert and belong to the city of Sequim. After 10 years, all the sale proceeds shall belong to the qualified household seller. However, if the property is sold by the qualified household to another qualified household at any time at the price then established by the Clallam County housing authority for the qualified household, all excess funds shall belong to the selling qualified household.

K. The city of Sequim shall establish an “Affordable Housing Fund” to receive the funds described in subsection J of this section, which funds will be used only to produce affordable housing in the city of Sequim. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.050 Preapplication required.

Preapplication review shall be required for all applications for planned unit development approval consistent with the provisions of Chapter 20.01 SMC. The following information shall be submitted concurrent with the request for preapplication:

- A. A completed preapplication form as provided by the department; and
- B. A preliminary sketch or conceptual design, graphically depicting the information requested in the preapplication form; and

C. A completed site analysis consistent with Section 18.22.015 SMC.

ED. At least one alternative sketch plan, of the same scale as the proposed plan, prepared to illustrate the results of strict adherence to the bulk, dimensional, use and density requirements of the underlying zoning district and the design standards contained in SMC Title 17. Alternative plans should be so labeled, and include a north arrow and a bar scale. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.060 Application requirements.

An application for PUD approval shall be submitted to the city public works and planning department and shall include 12 copies of all of the following materials:

- A. A completed official city of Sequim planned unit development application form.
- B. A preliminary plan drawn at a scale of no less than one inch equaling 100 feet which includes:
 - 1. North arrow;
 - 2. Bar scale;
 - 3. Acreage of proposed lots, tracts or areas;
 - 4. Dimensions of proposed lots, tracts and areas;
 - 5. Size and location of any existing and proposed structures;
 - 6. Proposed uses, including qualified affordable housing and building envelopes;
 - 7. Size and location of any existing or proposed streets, alleys and/or rights-of-way;
 - 8. Proposed ownership of streets, alleys and rights-of-way;
 - 9. Proposed open spaces or public or private dedications of land for trails, parks, and/or passive or active recreation;
 - 10. Any streams, irrigation ditches, drainage ditches, wetlands, ponds, floodways or other watercourses on or within 200 feet of the proposed project boundaries;
 - 11. Nature and extent of wooded areas, including boundaries of wooded areas, location of all trees greater than eight inches in diameter, location of all trees and plants identified as

species of local significance consistent with SMC Title 16, existing landscaping, steep slopes (more than 15 percent), and other significant physical features;

12. Location, size, and tree density of Native Vegetation Areas, consistent with 18.22.045 SMC.

13. Location and size of proposed LID stormwater management facilities, consistent with 18.22.035 SMC (if applicable).

14. Location and amount of total and effective impervious surface area.

15. Location, size, and brief description of any additional, proposed LID BMPs (if applicable).

16. Topography at two-foot contour intervals;

17. Proposed and existing easements for ingress, egress, utility corridors, irrigation ditch access, and other easements.

C. A preliminary circulation plan indicating the proposed movement of vehicles, goods, and pedestrians within the development and to and from adjacent public thoroughfares. Any special engineering features and traffic regulation devices needed to facilitate or ensure the safety of this circulation shall be shown, and a pedestrian circulation plan which addresses sidewalks, trails, on- and off-site existing and planned trail connections, relationship of the development to parks, shopping and recreational facilities, transit stops, lighting, safety and other pedestrian considerations.

D. Preliminary utility plans, including provisions for water, sewer, underground power where appropriate, telecommunications, and solid waste disposal, the location of adjacent utilities intended to serve the development, and a layout of existing and proposed utilities and utility easements within the development.

E. Preliminary road plans including plans, sections, and profiles.

F. Preliminary clearing and grading plans, including cut and fill amounts.

G. Preliminary stormwater drainage plans, prepared consistent with the requirements of SMC Title 13.

H. A statement as to the purpose of the planned unit development, describing in detail and with specificity which standards or requirements of either this title, or SMC Title 17, the planned unit development proposes to waive or alter. For each specific waiver or alteration, a statement must be given as to what public purpose is served or enhanced by the proposed waiver or alteration.

I. The intended phases of development, if any, prepared consistent with the requirements for phased development, Chapter 17.26 SMC.

J. The location of any areas proposed to be dedicated for public facilities and use.

K. A preliminary landscaping plan prepared consistent with the requirements of and incorporating the development standards contained in Chapter 18.46 SMC.

L. A critical areas checklist and SEPA checklist (if required during the preapplication).

M. A scaled vicinity map showing the subject property in reference to surrounding properties, streets, subdivisions, municipal boundaries, identified critical areas within a 500-foot radius, and including a north arrow.

N. A title report or subdivision certificate prepared by a title company.

O. Draft maintenance agreements and proposed management entities responsible for tax payments and maintenance of common facilities (such as roads, stormwater facilities, open spaces, trails, parks, etc.), and draft covenants, conditions and restrictions (CC&Rs).

P. A description of how off-site parking requirements associated with the proposal will be met.

Q. A completed major or minor subdivision or binding site plan application. Duplicate submittal requirements shall not be required; provided, that the completed application forms and all the information required for both the planned unit development application and the subject major or minor subdivision and/or binding site plan application is submitted.

R. Any additional materials, as determined by the department during the required preapplication meeting, considered necessary to fully evaluate the proposed subdivision.

S. A description of how the proposed affordable housing component, if applicable, will meet the criteria for qualified affordable housing.

T. A written statement from the Clallam County housing authority indicating what level of average median income the qualified affordable housing component will be applied. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.065 LID requirements.

PUDs shall meet the conventional volume reduction requirements of 18.22.035 SMC.

18.40.067 Native vegetation and impervious surface standards.

The native vegetation and impervious surface standards in 18.22.045 are preferred for all PUD projects.

18.40.070 Procedure – Fees.

Application fees shall be paid consistent with city of Sequim ordinances, as amended. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.080 Adequacy – Distribution of plans.

If, in the opinion of the planning department, the application contains sufficient data to determine approval or disapproval, they shall affix a file name or number and date of receipt to the application, forward copies of the preliminary plat to the appropriate agencies and officials, and notice the project consistent with the requirements of SMC Title 20, Land Use and Development. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.090 Procedure – Notice of hearing.

The planning department shall provide for notice of the public hearing consistent with the requirements of SMC Title 20, Land Use and Development. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.100 Technical review.

In addition to any relevant evidence received from the general public or the parties involved, the city engineer shall evaluate and determine the engineering accuracy of the proposed subdivision, including but not limited to the proposed street system, the proposed sewage disposal system, the proposed storm drainage system and the water supply system. The planning director shall evaluate and determine the proposal's conformance with the comprehensive plan and all zoning requirements. The public works director shall evaluate the adequacy of system improvements and capacity. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.110 Review criteria.

In addition to the minimum standards of this chapter, the comprehensive plan and all other applicable city and state regulations, the applicant for a PUD shall demonstrate compliance and consistency with all of the following criteria:

A. The PUD shall clearly demonstrate that it meets and/or exceeds the criteria of all applicable ordinances in regards to protecting the natural environment by providing the following:

1. An energy-efficient site design;
2. A design which protects critical and resource areas and is situated to minimize alteration of significant natural features such as wetlands, streams, ravines, rock formations, mountains, steep cliffs, locally significant plant species, lakes, irrigation districts and other water bodies, and other similar natural features;
3. A design which locates structures, circulation systems and utilities in a manner which minimizes the alteration of the land;
4. A site design that minimizes impervious surfaces; and
5. A site design that reduces dependency on automobiles by providing for pedestrian, bicycle and transit uses.

B. The PUD shall clearly demonstrate that it is consistent with the goals and policies of the comprehensive plan and that it enhances the public welfare through:

1. Provision of affordable housing (if applicable); and
2. Provision of appropriate building types of a design and scale that contributes to the maintenance of neighborhood character; and
3. Provision of public facilities and/or amenities, including public spaces, open spaces, pedestrian facilities, and/or recreational facilities; and
4. Establishment of plantings and landscaped areas that provide visual relief for future project residents and the surrounding neighborhood.

C. The PUD shall be consistent with the goals and policies of the shoreline management master program, and any other applicable statutes, ordinances, plans, or programs.

D. The PUD shall result in a positive contribution to the community that could not be achieved through standard platting and zoning procedures. The PUD shall demonstrate that the benefits and improved design of the proposed development justify the variation from the normal requirements of this code through the application of the planned unit development overlay district. For PUDs incorporating qualified affordable housing, a design review meeting will be required to ensure the consistency of architectural style and compatibility with the adjacent structures and land uses.

E. The PUD shall provide sufficient facilities and services, including easements, rightsof-way, utilities, stormwater facilities, fire protection and other services, which may be necessary, appropriate, or desirable for the support of the development.

F. The PUD shall be designed and arranged to relate to surrounding properties and to minimize adverse off-site impacts due to noise, traffic and/or incompatible land uses. The PUD shall promote compatibility among land uses within and adjacent to the development. Planned unit developments that propose the maximum degree of flexibility may be required to provide buffers or “transitional development areas,” where development is planned which more closely matches the standards and criteria of the underlying zoning district. “Transitional development areas”

may be required adjacent to public roads, public parks and schools, and/or established neighborhoods.

G. If a PUD will be phased, each phase of a proposed PUD must contain adequate infrastructure, open space, recreational facilities, landscaping and all other conditions of the PUD to stand alone if no other subsequent phases are developed, consistent with the requirements of Chapter 17.26 SMC.

H. The PUD shall be consistent with the intent and purpose contained within this chapter.

I. If no reasonable conditions or modifications can be imposed to ensure the application meets the criteria set forth above, then the application shall be denied. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.120 Property use and development agreement (PUDA) – Required.

The council, in granting approval of the planned unit development, may attach conditions and requirements. Unless other arrangements are agreed to by the city, the owners and/or developers shall be responsible for paying the cost of construction and/or installation of all required on- and off-site improvements. This responsibility and all conditions and requirements of approval shall be the subject of a property use and development agreement (PUDA) between the owner and/or developer and the city. The PUDA may include provisions to allow for the posting of performance bonds, consistent with the requirements of SMC 17.64.020, and shall include specific statements with regard to the relationship between PUD approval and final plat and/or final plan approvals. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.130 Protective covenants.

The applicant or applicants shall be required to submit a proposed declaration of covenants and restrictions or suitable alternative mechanism to govern development within the PUD. This document or mechanism shall be reviewed and approved by the city as to content as well as legal form and effect at the time of consideration of the PUD. It shall be the purpose of the aforementioned document or mechanism to ensure high aesthetic quality of structures and grounds, continuing maintenance of development, and also to provide a mechanism allowing a degree of mutual input regarding the regulation of continuing development character and maintenance of the PUD. The restrictive covenants or alternate mechanism shall contain provisions for the following:

A. A development association shall be established with mandatory membership for all landowners and leaseholders in the PUD. The development association shall, if applicable:

1. Review and approve site plans for proposed development within the PUD prior to submission to the city for approval;
2. Be given authority to require maintenance of structures, landscaping, or other site development where individual owners or leaseholders are not providing adequate maintenance; and
3. Be given other powers or duties, such as maintaining all landscaping, etc., as may be approved by the council.

B. The covenants or alternative mechanism should establish standards for such items as

architectural character, allowable construction materials and structural types, recommended landscaping, allowable signs, setbacks, and other items; provided, that no standards shall be less restrictive than the standards specified in the applicable PUD and that all garages be no smaller than 20 feet by 20 feet; except, that where other units in the PUD or subdivision have other off-street parking provisions, such affordable housing shall utilize the same offstreet parking provisions as such other units in the PUD or subdivision. The exterior design, appearance and parking solutions (including garages) must be compatible with the rest of the development except for the sizes of the houses. All single-family affordable units will have a minimum of 1,000 square feet of living space not including garages, patios, sheds or decks.

C. Any declaration of covenants and restrictions shall run with the land and shall be binding upon all heirs, successors, and assigns, and shall be filed with the county auditor prior to the issuance of any development permits for any property within the PUD and shall inure to the benefit of the city as well as all landowners and leaseholders in the PUD. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.140 Minimum development standards.

Planned unit developments shall be developed in conformance with the development standards contained in Chapter 18.22 SMC, other applicable city and/or county codes and regulations, and with the following minimum development standards:

A. Sewer and Water. All new single-family residential lots less than one acre in size, and all multifamily, commercial, mixed use and industrial lots shall be provided with municipal sewer and water services. All lots greater than one acre may be developed with on-site sewer systems and on-site water systems consistent with the requirements of the county health department and the service extension review process (SERP) if future redevelopment opportunities are preserved.

B. The design, shape, size, and orientation of lots shall be adequate and appropriate to the use for which the lots are intended. Creativity in lot layout and configuration is encouraged.

C. Schools and School Grounds. Applications for PUD approval shall be reviewed by the school district in order to ensure that provisions for schools, school bus stops and school grounds receive adequate and appropriate consideration.

D. Transit and Bus Stops. Applications for PUD approval shall be reviewed by Clallam Transit and the school district to determine whether transit and/or school bus stops are necessary to promote public access to safe and convenient travel.

E. Sidewalks, Pathways and Trails. Application for PUD approval shall be reviewed in order to ensure that provisions necessary to provide safe walking conditions for pedestrians receive adequate and appropriate consideration. A pedestrian plan shall be required which addresses on-site and off-site existing and planned trail connections, relationship of the development to parks, shopping and recreational facilities, transit stops, lighting, safety and other pedestrian considerations.

F. Open Space, Parks and Recreational Facilities. Applications for PUD approval shall provide adequate and appropriate open space and recreational facilities for the proposed uses. Open space areas that are of a size and type which provide a roughly proportional mitigation to open space and recreational impacts directly

attributable to the proposed project shall be established. Open space shall be usable by PUD residents for active and passive recreation, and shall meet the following criteria:

1. Open spaces may include the following types of uses:
 - a. Parks, picnic areas, ballfields, and play areas;
 - b. Improved trails, including benches, and landscaping, which connect spaces to each other;
 - c. Squares, amphitheaters, and/or urban gathering spaces;
 - d. Botanical gardens, water features (if accessible), and arboretums;
 - e. Preservation and/or enhancement of unique natural features beyond that required by the critical areas protections contained in this code, where the preservation of these open spaces includes additional protection measures which may limit public use; the proponent shall provide interpretive signage or displays to educate the public as to the values and function being presented;
 - f. Preservation of working farms and/or agricultural buildings; and/or
 - g. Other uses, with the approval of the planning director, excluding all of the following:
 - i. Those open space areas that are inaccessible from the development;
 - ii. Those open space areas that are otherwise protected as critical areas or their buffers;
 - iii. Those open space areas established only for the purpose of providing a “buffer” between incompatible developments, or between lots, rights-of-way, easements, and improvements;
 - iv. Utility easements and stormwater facilities that have not been improved beyond their infrastructure function; and
 - v. Road rights-of-way, including pedestrian improvements provided within a road right-of-way.

G. Landscape Standards. Applications for PUD approval shall meet or exceed the landscaping requirements of Chapter 18.46 SMC.

H. Provision of Sufficient Facilities and Services. The PUD shall provide sufficient facilities and services that may be necessary, appropriate, or desirable for the support of the development. These may include, but shall not be limited to, availability of utilities; transportation routes of adequate size and capacity accessing the site; police and fire services; and social and health services. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

18.40.150 Amendments.

Amendment of a planned unit development shall be permitted consistent with the procedural requirements of SMC Title 20 and the following requirements:

A. Major Changes. Major changes to a final planned unit development shall be considered to be an amendment to the proposed PUD and shall be subject to application, notice, hearing and appeals in the same manner as the original application.

B. Minor Changes. Minor changes to a final planned unit development may be approved provided the changes do not:

1. Increase density;
2. Change the boundaries of the planned unit development to include lands not previously included within the final plan or plat;
3. Change the approved type of use; and

4. Do not substantially change the location or amount of land devoted to specific land uses.

C. A change shall not be considered to be minor if it alters or in any way changes the conditions of approval set forth in the planned unit development agreement (as amended).

D. Major and minor changes to planned unit developments shall concurrently amend the applicable underlying land use application (subdivision and/or binding site plan), as per the requirements of SMC Title 17, Subdivisions. (Ord. 2006-016 § 4; Ord. 98-006 § 4, Exh. B)

Chapter 18.44
BULK AND DIMENSIONAL REQUIREMENTS

Sections:

- 18.44.010 Purpose.**
18.44.020 Bulk, dimensional and general requirements.
18.44.025 LID requirements.
18.44.030 Exceptions.
18.44.040 Setbacks, zero lot line and minimum lot width.
18.44.050 Sight clearance.
18.44.060 Road classifications.

18.44.010 Purpose.

In recognition of the varied topography and geographical relationships within the city and with consideration for the health, safety, and general welfare of the citizens, bulk, dimensional and general requirements for the zoning districts shall be required as a necessary part of the development and use of land. All permitted uses, conditional uses and special uses, except as indicated by Chapter 18.56 SMC, Essential Public Facilities and Special Property Uses, and Chapter 18.40 SMC, Planned Unit Developments, shall comply with the requirements of this section. (Ord. 2006-016 § 5; Ord. 97-019 § 4, Exh. B)

18.44.020 Bulk, dimensional and general requirements.

Bulk, dimensional, and general requirements are herewith established and shall be provided in accordance with the minimum standards hereinafter set forth in Table 18.44.020(A), Table 18.44.020(B), and Table 18.44.020(C).

Comment [Id1]: Note: Per City's request, the existing definition of lot coverage in 18.08 has been revised to include all impervious surface coverage.

Table 18.44.020(A) – Bulk, Dimensional and General Requirements: Residential

Zone	Minimums								Maximums	
	Lot Size	Lot Width	Required Setbacks						Lot Coverage	Building Height
			Front				Side (each) ¹	Rear		
			Loop, etc.	Local	Collector	Arterial				
R-II	6,250 square feet	50'	20'	25'	30'	35'	10'	15'	75%	35'
R-III	6,250 square feet; density allowed 3,000 square feet per unit	50'	20'	25'	30'	35'	10'	15'	75%	35'
R-IV	6,250 square feet; density allowed 2,000 square feet per unit	50'	20'	25'	30'	30'	10'	15'	75%	50'
R-IVA	One off-street parking space per unit	50'	10'	10'	20'	20'	5'	5'	N/A	35'

¹ Zero lot line construction may be allowed; however, the minimum distance between buildings must be 10 feet and 10 feet from any side street. Distance is measured from the furthest protruberance of any structure (eaves, etc.).

Table 18.44.020(B) – Bulk, Dimensional and General Requirements: Commercial

Zone	Minimums								Maximums	
	Lot Size	Lot Width	Required Setbacks						Lot Coverage	Building Height
			Front				Side (each)	Rear		
			Access Road	Collector Road	Minor Arterial	Major Arterial				
C-I(NC)	None	None	25'	30'	35'	35'	5'	5'	85%	35'
							20'	20'	From existing single-family residential	
C-II(G) ¹ C-II(M) ¹ C-II(S) ¹	None	None	0'	0'	0'	0'	0'	10'	75%	35'
							20'	20'	From existing single-family residential	
C-III ¹	None	None	0'	0'	0'	0'	0'	10'	75%	35'
							35'	35'	From existing single-family residential	
C-IV Overlay	None	None	50'	50'	50'	50'	10'	10'	75%	35'
							35'	35'	From existing single-family residential	

¹ Setbacks for stand-alone multifamily structures shall be consistent with the R-III setbacks.

Table 18.44.020(C) – Bulk, Dimensional and General Requirements: Mixed Use and Industrial

Zone	Minimums								Maximums	
	Lot Size	Lot Width	Required Setbacks						Lot Coverage	Building Height
			Front				Side (each)	Rear		
			Access Road	Collector Road	Minor Arterial	Major Arterial				
M-I	10,000 square feet	100′	25′	30′	35′	50′	20′	20′	80%	35′
M-II	10,000 square feet	100′	25′	30′	35′	50′	50′	50′	85%	35′
MU	Multifamily	50′	20′	25′	30′	35′	10′	15′	75%	35′

(Ord. 2006-016 § 5; Ord. 2005-028 §§ 6, 7; Ord. 97-019 § 4, Exh. B)

18.44.025 LID requirements.

For LID requirements, see SMC 18.22.035.

18.44.030 Exceptions.

The bulk, dimensional and general requirements found in SMC 18.44.020 shall apply to specifically permitted and conditional uses tabulated in Chapter 18.60 SMC, excepting the following:

A. The side and rear setbacks provided in SMC 18.44.020 shall not apply to outbuildings found in residential or agricultural uses such as detached garages, storage sheds or tool sheds, excepting that all buildings shall be a minimum of five feet from side and rear property lines and 10 feet from any street right-of-way or alley and 10 feet from any building on the same or adjacent properties.

B. The maximum building height provided in SMC 18.44.020 shall not apply to towers and antennas; provided, that towers and antennas are setback from all exterior property lines at a minimum ratio of one foot of setback for every three feet of vertical height as measured from grade.

C. Antennas, satellite dishes, or other communication devices shall not be located in the front setback area.

D. All structures excepting fences, hedges, and berms, shall not be established within the front setback area.

E. Subdivisions or planned unit developments platted or permitted consistent with Chapter 17.43 SMC, Innovative Lot Design Standards, may specifically delineate setback, bulk, height or dimensional requirements which differ from these standards. (Ord. 97-019 § 4, Exh. B)

18.44.040 Setbacks, zero lot line and minimum lot width.

All setbacks shall be measured from the lot line to the building line as defined in Chapter 18.08 SMC.

A. Zero Lot Line Purpose. The purpose of zero lot line development as described in this section is to:

1. Provide more usable private open space;
2. Promote the efficient use of land; and
3. Protect environmentally sensitive areas.

B. Zero lot line homes provide for greater usable yard space on each lot and allow for the more efficient subdivision of land. Because the location of each structure is defined before subdivision approval, greater flexibility in site development standards is possible while at the same time assuring that the single-family character of the development is maintained.

C. Zero Lot Line Requirements.

1. Building Setbacks. For zero lot line development, a dwelling unit may be placed on one interior side property line, giving it one zero side/interior setback. If it is an interior lot line, the setback standard from the other side property line shall be 10 feet.

2. Privacy. In order to maintain privacy, no windows, doors, air conditioning units, or any other types of openings in the walls along a zero lot line shall be allowed except where such openings do not allow for visibility into the side yard of the adjacent lot, such as a clerestory skylight or opaque window.

3. Eaves. Eaves along a zero lot line may not project over the adjacent property line.

4. Maintenance. The building wall along the zero lot line shall be maintained in its original color and treatment unless otherwise agreed to in writing by the two affected lot owners.

5. Platting Requirements. The major or minor subdivision shall show the approximate location of buildings proposed to be placed within the required setbacks. (Ord. 2006-016 § 5; Ord. 97-019 § 4, Exh. B)

18.44.050 Sight clearance.

All corners subject to yard requirements shall maintain, for safety purposes, a triangular area in which no physical obstruction, such as a structure, fence, tree or shrub higher than 42 inches above grade shall be permitted. Such triangular area shall have one angle formed by the front lot line and the side lot line separating the lot from the side street, the length of which lot line sides of the triangle shall be 15 feet. The third side of the triangle shall be a line connecting the two lot lines at the 15-foot point on each. (Ord. 97-019 § 4, Exh. B)

18.44.060 Road classifications.

The purpose of establishing road classifications is, to clarify the setbacks for development activities consistent with the requirements of this section. The following road designations shall apply:

- A. Arterials.
 - SR 101 By-Pass;
 - Existing Highway 101 (Washington Street);
 - Old Olympic Highway;
 - Sequim-Dungeness Way, North and South Sequim Avenues.
- B. Collectors.
 - 5th Avenue (north of Prairie);
 - 7th Avenue (south of Hwy. 101);
 - 9th Avenue (north of Hwy. 101);
 - Blake Avenue;
 - Brown Road;
 - Fir Street;
 - Hammond Street;
 - Hendrickson Road;
 - Keeler Road;
 - Maple Street;
 - Miller Road;
 - Port Williams Road;
 - Prairie Street;
 - Priest Road;
 - River Road;
 - Simdars Road;
 - SR 101 By-Pass South Frontage Road;
 - Still Avenue;
 - West Sequim Bay Road;
 - White Feather Way.

(Ord. 97-019 § 4, Exh. B)

**Chapter 18.48
OFF-STREET PARKING**

Sections:

18.48.010	Intent and purpose.
18.48.020	Application.
18.48.030	General provisions.
18.48.040	Minimum parking space and lot dimensions.
18.48.050	Minimum number of spaces required.
18.48.060	Minimum loading space requirements.
18.48.070	Modified calculations for required on-site parking spaces.
18.48.080	Parking lot location, construction and design.
18.48.090	Access and driveway approach regulations from streets and alleys.
18.48.100	Parking and storage of recreational vehicles, boats and trailers on residential property.
18.48.110	Parking of commercial vehicles in residential zones.
18.48.120	Commercial storage of vehicles.
18.48.130	Town center sub-area parking space requirements.
18.48.131	Application (sub-area).
18.48.132	Off-street parking and loading space requirements (sub-area).
18.48.133	Use of public parking (sub-area).
18.48.134	Alternative means of meeting on-site parking requirements (sub-area).
18.48.135	Access and design (sub-area).
18.48.140	Special assessment area for maintenance and parking development.
18.48.145	Variances.

18.48.010 Intent and purpose.

The intent and purpose of these off-street parking regulations is to provide for the orderly establishment of parking opportunities within the community while maintaining the general welfare, safety and attractiveness for the residents and users of the parking facilities. For the purposes of this chapter recreational vehicle shall refer to all motor homes, campers, utility trailers, living trailers, boats and boat trailers and similar vehicles. On-street parking and the use of the public right-of-way is regulated by SMC Title 10, Vehicles and Traffic. (Ord. 2003-017 § 1)

18.48.020 Application.

A. The provision of required off-street parking spaces, covered spaces, drive-through spaces, loading spaces, handicapped-accessible spaces, bicycle spaces and parking lots constructed to the standards established by this code, except as otherwise allowed by this chapter, shall apply to the following:

1. New nonresidential land use and/or the construction of new nonresidential buildings.
2. New construction where the floor area or outdoor use area proposed for expansion of an existing nonresidential land use increases the parking demand and the required number of parking spaces.
3. A change in use of an existing residential property that results in an intensification of the land use relative to parking demand and the required number of parking spaces.
4. Establishment or construction of a new residential dwelling unit or expansion of a residential unit by more than 50 percent of the original floor area.

B. No certificate of occupancy shall be issued for the use of any building or site nor a building or site improvement permit issued for the erection or alteration of any building or site unless such use or building complies with the regulations of this section. This shall not be interpreted to interfere with the continued use of a legally nonconforming site or building as provided for in this chapter.

C. Except as otherwise required by this chapter existing legal nonconforming parking facilities may

remain and be maintained as established unless there is a danger to the public health, safety or welfare.

1. Except as otherwise specifically required by this chapter for legal nonconforming uses or other city permits, improvements, repair or maintenance to existing legal nonconforming parking facilities, i.e., landscaping, drainage, surface seal coat, slurry coat or asphalt overlay of existing paved portions of parking lot, and re-striping are not governed by this chapter; provided, that work neither requires nor provides for any additional access to city streets or alleys.

2. Any expansion of existing legal nonconforming parking lots shall require that the expanded portion conform to the provisions of this chapter.

3. Voluntary improvements to legal nonconforming uses and/or expansion of legal nonconforming uses shall not be required to comply with the minimum number of spaces required.

4. The application of this chapter to the expansion of spaces provided for a nonconforming use that is triggered due to a change of use shall only be to the difference between that required for the existing use and the new use.

D. Requirements for uses not specifically listed in this chapter shall be determined by the planning director, based on the requirements of comparable uses and upon the particular characteristics of the use and/or other provisions of this chapter.

E. The numbers and dimensions of parking and loading spaces required by this chapter shall be considered the minimum required, unless otherwise provided, and additional parking may be required based on the nature of the use and anticipated demand. On-street parking shall not be counted toward compliance with the minimum number of spaces required except in the town center sub-area (SMC 18.48.130). (Ord. 2003-017 § 1)

18.48.030 General provisions.

A. All parking spaces, loading spaces and parking lots shall be maintained and kept available for their intended use and vehicle size and shall not be discontinued, reduced, or altered in any way without approval of the planning department and in compliance with the requirements and standards of this chapter.

B. All required guest, ADA, loading, compact, or other restricted spaces shall be designated as such and restricted to such use.

C. No repair work or servicing of vehicles shall be conducted on designated parking areas.

D. Required fractional spaces shall be counted as a space.

E. Off-street parking and parking lots constructed, even when not required by this chapter, shall be constructed and maintained in compliance with the development and use standards of this chapter.

F. No property shall be used for the sale of more than one vehicle, or the parking and/or storage of a vehicle except as in compliance with the provisions of this chapter. Except as otherwise noted, all vehicles shall be provided with a parking surface in compliance with the design and development standards for parking spaces and parking lots in this chapter.

G. All parking lot construction/improvements/expansions, drainage, landscaping and striping plans of existing parking lots shall be approved by the planning and public works departments for compliance with the requirements of this chapter and title.

H. Grading and paving of parking lots shall be in compliance with the permits and standards required in SMC Title 15, Buildings and Construction, and with the stormwater management requirements of the city of Sequim. All associated construction within a public right-of-way, including driveway approach construction and landscaping, requires the approval of an encroachment and access permit from the public works department, with associated bonding or other surety for completion of the work and compliance with all adopted traffic control and safety regulations and procedures. (Ord. 2003-017 § 1)

18.48.040 Minimum parking space and lot dimensions.

A. Parking Stall Size:

- | | |
|----------------|--------------------|
| 1. Residential | 9 feet by 19 feet. |
| 2. Commercial | 9 feet by 19 feet. |

- 3. Compact 8 feet by 15 feet.
- 4. *ADA Accessible Van: 8 feet by 19 feet plus 8-foot unloading area.
Car: 8 feet by 19 feet plus 5-foot unloading area.
- 5. RV 10 feet by 30 feet.
- 6. Parallel 8 feet by 23 feet.
- 7. Drive-through 8 feet by 20 feet.
- 8. Diagonal 30, 45 and 60-degree parking space sizes are identified in SMC 18.48.040(B).

* Dimensions may not be less than state-adopted standards. ADA spaces shall be provided at one space/25 spaces. Unloading area may be on either side of parking stall.

B. Table for standard size parking angles (does not include two-foot allowance for overhang or interlock reduction).

A	B	C	D	E
0	8'	8'	23'	12'
30	9'	17'	18'	12'
45	9'	19'	12.7'	14'
60	9'	20.5'	10.4'	15'
90	9'	19'	9'	24'

A = Parking angle

B = Stall width

C = Stall depth from curb to drive aisle

D = Width at curb

E = Aisle width, one-way

C. Backup space shall be 24 feet except for diagonal spaces accessed by a one-way drive aisle.

D. Drive aisles from which no parking is directly accessed shall be a minimum of 20 feet in width for two-way and 12 feet in width for one-way.

E. There shall be a two-foot overhang allowance into landscaping, hardscape buffers or sidewalk areas; provided, that the sidewalk maintains a width of no less than five feet. (Ord. 2003-017 § 1)

18.48.050 Minimum number of spaces required.

A. Off-street parking ratios expressed as the number of spaces per square feet means net square footage. Net square footage is calculated as 85 percent of the gross square footage of the structure. Public parking spaces, either on-street or in public parking lots, shall not be included in parking calculations. The applicability of parking on private streets shall be determined during project approval.

B. The required number of parking spaces for each type of land use shall be as stipulated below, except as the requirements may be modified or installation phased by other sections of this chapter including SMC 18.48.070, Modified calculations for required on-site parking spaces, and for uses within the town center sub-area:

1. Residential:

- a. Single-family detached/attached, duplexes, triplexes and fourplexes: two spaces/unit.
- b. Multifamily (five or more units): one and one-half spaces/unit.
- c. Mobile home parks: two spaces/unit.
- d. Group facilities: one space/three beds.

2. Commercial (except for properties located in the downtown sub-area):

- a. Retail: one space/250 square feet minimum.
- b. Restaurants: one space/table; plus one space/four stools; plus one space/ employee based on largest shift.
- c. Bank and professional office (except medical): one space/300 square feet.
- d. Medical office: one space/200 square feet.

- e. Gyms and aerobic studios: one space/50 square feet.
- f. Hotels and motels: one space/unit plus one employee space/10 units, plus parking for accessory uses by type and one RV parking space/10 units.
- g. Outdoor product display areas: one space/1,000 square feet of display or sales area. Will require temporary activity permit.

3. Industrial:

- a. Manufacturing: one space/750 square feet.
- b. Warehousing: one space/1,500 square feet up to 10,000 square feet and one space/2,000 square feet over 10,000 square feet.
- c. Research and development: one space/500 square feet.
- d. In addition to above industrial uses, employed drivers taking vehicles off-site for delivery or construction shall provide one space/driver.
- e. Office space in industrial uses: one space/250 square feet.

4. Public and semi-public uses including public schools, parks and athletic facilities: While the exact number of spaces shall be determined through the special use permit process, the following minimums shall apply:

- a. Hospitals and convalescent care facilities: one space/longer-term care bed and one space for each 200 square feet of outpatient area.
- b. Schools: one space/classroom; plus one space/250 square feet of office area; plus one space/100 square feet of kitchen area; plus one guest space/five required spaces; plus 10 spaces/classroom for high schools and colleges.
- c. Churches: one space/three seats in the largest assembly area.
- d. Theaters: one space/three seats.
- e. Library: one space/300 square feet.
- f. Museum and art gallery: one space/500 square feet.
- g. Clubs and lodges: one space/two seats.
- h. Sports facilities/auditoriums: one space/three seats.
- i. Technical school: one space/100 square feet.

5. For unnamed uses, the number of spaces required may be based on a similar listed use or on a study provided by a recognized professional in the area of parking and trip demand.

6. For projects that combine a mix of uses, the requirement shall be calculated by the addition of the total required for each use area by square footage; the provisions for shared parking in this chapter may be applied.

7. Compact spaces:

- a. Up to 20 percent of the number of required spaces over 20 may be compact.
- b. Compact spaces shall be clearly designated. (Ord. 2003-017 § 1)

18.48.060 Minimum loading space requirements.

A. Size. Loading space sizes shall be dimensioned to accommodate the type of vehicle intended for use; however, the following minimums shall apply where loading spaces are required:

- 1. Type A Space equals 10 feet by 30 feet with 15 feet vertical clearance.
- 2. Type B Space equals 12 feet by 40 feet with 15 feet vertical clearance.

B. Location. Loading spaces shall be adjacent to the doors they serve and be separated from parking spaces and not interfere with parking and pedestrian circulation.

C. Numbers. In addition to the minimums listed below, each loading door shall have an associated loading space. All loading spaces shall be designated with striping.

Type of use	Floor area	Number of spaces required
Commercial	0 – 10,000	Not required
	10,001 – 20,000	1 Type A
	Over 20,000	1 Type B
Industrial	0 – 5,000	1 Type A
	5,001 – 15,000	1 Type B

	15,001 – 50,000	2 Type B
	Over 50,000	3 Type B
Public	As required by use permit.	

(Ord. 2003-017 § 1)

18.48.070 Modified calculations for required on-site parking spaces.

In addition to the following, see SMC 18.48.080(B), Parking lot location, regarding the use of off-site parking.

A. Common Use of Facilities. Common parking areas may be shared for independent uses where the total number of spaces provided equals the sum of that required for the individual uses. Where there is assurance, such as a document recorded to run with the land, the parking will always be accessible to all parties. ADA accessible parking requirements shall be based on the total number of spaces provided.

B. Joint Use of Facilities. A minor conditional use permit may be issued for joint use of parking facilities, i.e., where the same parking spaces are used by different uses at different times, under the following conditions:

1. Up to 50 percent of the parking required for a use that normally operates in the daytime may be credited to a use that normally operates at night or vice versa.

2. Up to 100 percent of the parking required for a church or school may be credited to another use during periods when the church or school is not active.

3. The use for which the joint use is requested must be located within 600 feet of the parking facility.

4. The applicant shall provide evidence that such joint use will not create a conflict or overlapping use of the parking facility.

5. A written agreement shall be recorded with the Clallam County auditor to run with the land that ensures the parking facility will be available for as long as the joint use is required.

C. Parking Studies. An applicant may request a modification, to be allowed by the approval body, to the minimum number of parking or loading spaces required, by providing a study from a qualified professional that substantiates that parking demand can be met with a reduced requirement due to such factors as drive-by trip capture, hours of operation, or alternative transportation availability for the customer base.

D. Transit-Oriented Development. Transit-oriented developments, approved as a planned unit development, or commercial uses, approved under the provisions of a binding site plan, may propose reduced parking requirements in lieu of provisions for alternate modes of transportation. (Ord. 2003-017 § 1)

18.48.080 Parking lot location, construction and design.

A. General Criteria. All parking lots and spaces constructed shall comply with the following unless specifically altered by some other provision of the Sequim Municipal Code, design guidelines or as modified where allowed in approval of a use permit.

1. Parking lots and spaces shall be constructed of either asphalt concrete (AC) or Portland cement concrete (PCC) or permeable surfacing materials using low impact development (LID) strategies where feasible and practicable. LID design and construction for parking lots shall be consistent with LID-01 through LID-08 in the city of Sequim's SUDR and the LID Technical Guidance Manual for Puget Sound (January 2005)

2. Comply with the city of Sequim requirements for grading, drainage and stormwater management.

3. Provide adequate directional signs.

4. Provide for safe pedestrian access to building and public sidewalks.

5. Provide for through circulation, limiting the need for backup maneuvers.

6. Drive-through queues shall be designed so that overflow will not interfere with public streets or

main drive aisles in shopping centers.

7. All parking lots shall comply with Washington State regulations relative to access by persons with disabilities.

8. No parking space shall obstruct a doorway or exit from a structure.

9. Parking stalls shall be clear of all obstructions that limit the use thereof.

10. A parking space shall not be located so as to cause a visual obstruction.

11. Loading spaces shall not obstruct pedestrian or vehicle circulation.

12. Wheel stops shall be provided in the form of continuous curbs or sidewalk edges. Freestanding wheel stops shall not be permitted except with the approval of the planning director.

13. Water drainage to and from the parking lot shall not cross sidewalks.

14. Parking lots shall be designed to permit on-site turn-around and to permit vehicles to enter and exit the site in a forward motion.

15. All fire lanes, compact parking spaces, ADA accessible spaces, and loading areas and turn-around areas shall be appropriately marked.

16. Drive-Through Lanes. Drive-through queuing lanes shall accommodate a minimum of four passenger vehicles and shall not obstruct the free flow of vehicle circulation loading areas or pedestrian access. They shall be a minimum of 10 feet in width.

B. Location.

1. Required parking spaces may be located off site with concurrence of the body approving the parking lot if a document is recorded to ensure the continued availability of the spaces for the life of the use or until such time as other spaces are made available, they comply with the development standards of this code and do not reduce the required number of spaces available for the use located on the off-site property.

2. The location requirements for this section may be altered through approval of a use permit, PUD or binding site plan where the intention of the code for user convenience is met and safe and direct pedestrian pathways are provided from parking to the use.

C. Landscaping.

1. Parking spaces shall be separated from public sidewalks with landscaped planters that shall be a minimum of 10 feet when associated with a parking lot of 50 spaces or greater.

2. A minimum five-foot-wide planter or raised PCC or AC buffer shall separate parking spaces from on-site sidewalks, poles, signs, fences, and buildings.

3. For every 30 adjacent parking spaces, landscape areas shall be provided. These areas may be coordinated with parking lot illumination, stormwater conveyance areas, or other amenities.

4. Landscaped areas shall be separated from paving by a raised concrete curb. Curb cuts are permitted when associated with stormwater conveyance.

5. There shall be one tree for each 10 parking spaces in a lot.

6. Parking lot landscape areas shall comply with any adopted city landscape and irrigation regulations.

7. Separate parking lots with landscape and/or hardscape buffers from public sidewalks and buildings. Buffers should be a minimum of five feet in width. Buffers adjacent to the public right-of-way, except for alleys, shall be landscaped and have 10 feet minimum width for parking lots with more than 50 spaces.

8. Landscaping shall not exceed three feet in height within an intersection view triangle.

9. At the discretion of the planning director, incorporation of low impact development strategies may substitute for required spaces. This shall not be in lieu of required landscaping.

10. At the discretion of the planning director, LID stormwater management facilities may be incorporated into required landscaping (i.e. bioretention swales), provided that site and soil conditions make LID feasible and that the purpose and intent of required landscaping is not compromised.

18.48.090 Access and driveway approach regulations from streets and alleys.

The number, size and location of driveway access to public streets and alleys shall be limited as follows:

A. General.

1. Minimum 30-foot separation from back of curb return at intersections.
2. In lieu of the standards below, major development may use divided driveways or curb returns in lieu of driveway approaches as necessary to accommodate traffic and turning movements.
3. Driveway approach shall be clearly defined through use of landscaping.
4. Driveways into commercial, industrial or multifamily residential projects shall be aligned with existing or future driveways on the opposite side of the street where left turns are allowed. They may be minimally offset where no left turn conflict is created; otherwise there shall be a minimum of 200 feet of separation to allow for opposing left turn lanes.
5. Service, one-way restricted, or other special situation drive approaches shall be clearly designated.

B. Commercial and Industrial Developments.

1. Limit width to 30 feet or one-half width of frontage, whichever is less.
2. Use a four-foot-wide flare approach.
3. Design approach for weight of trucks.
4. Avoid cross traffic near entrance.
5. Allow vehicles to fully enter site before potential obstruction from cross traffic or backups.
6. Define location with landscaping.
7. Provide for safe pedestrian crossing of driveways.

C. Residential.

1. Single-Family/Duplex/Triplex.
 - a. Limit to one access frontage.
 - b. Limit driveway access to arterials or major collectors.
 - c. Maximum 20-foot width or one-half of lot width, whichever is less.
 - d. Use two-foot flares at approach.
2. Multifamily.
 - a. No access to spaces directly from street.
 - b. Access shall be to lowest street category for corner lots. (Ord. 2003-017 § 1)

18.48.100 Parking and storage of recreational vehicles, boats and trailers on residential property.

See also Chapters 10.12, 10.13 and 10.14 SMC. Noncommercial recreational vehicles, trailers and boats and trailers may be parked and stored on residential property only in conformance with the following conditions:

A. May not be utilized as a residence unless a permit has been obtained for a period of not to exceed seven calendar days. A maximum of four permits may be obtained in any calendar year.

B. In mobile home parks, planned unit developments and apartment complexes:

1. Recreational vehicles may not be parked in spaces provided for passenger vehicle parking.
2. Recreational vehicles, trailers and boats and trailers shall be parked and/or stored as provided for in the development approval of the project.

C. For single-family detached houses, duplexes and triplexes, off-street parking is allowed so long as they do not block pedestrian traffic on the sidewalks and only as set forth in this subsection.

1. Front yard: No such vehicle shall be parked in the front of a residence except in a driveway for a period not to exceed 24 hours.
2. Side yard: No such vehicle shall be parked on the side yard except on a driveway or pad, provided the recreational vehicle is not extended beyond the front of the house.
3. Rear yard: A vehicle may be parked or stored in the rear yard; provided, that it be placed

on a pad and placed so as not to obstruct the sight distance in alleyways and not in the alley right-of-way. (Ord. 2005-014; Ord. 2003-017 § 1)

18.48.110 Parking of commercial vehicles in residential zones.

Commercial vehicles greater than 12,000 pounds (gross vehicle weight), other than those allowed through a home occupation permit per Chapter 18.67 SMC, may not be parked or stored in residential zones except for the period of time required to make legitimate deliveries or pickups. (Ord. 2003-017 § 1)

18.48.120 Commercial storage of vehicles.

A. Commercial vehicles shall be stored in approved designated locations and shall not obstruct the use or access to parking spaces.

B. Striping is not required in vehicle storage areas; however, required drive aisles and fire lanes must be designated and be kept clear of obstructions.

C. Alternative all-weather surfaces may be permitted for storage of nonmotorized vehicles and trailers where there is no significant danger from leakage of fuel or lubricants. (Ord. 2003-017 § 1)

18.48.130 Town center sub-area parking space requirements.

A town center sub-area has been identified for the historic commercial center of Sequim. The parking regulations in the sub-area attempt to incorporate the uniqueness of this area and the challenges, limitations and opportunities this area presents. (Ord. 2003-017 § 1)

18.48.131 Application (sub-area).

The provisions of SMC 18.48.130 and this section through 18.48.135 shall apply to all properties within the geographic area of the town center sub-area. Sections of this chapter not specifically modified by these sub-area requirements shall be applied. Existing legal nonconforming parking shall be maintained at its present level in a manner safe to the users and general public and where it is not detrimental to public or private improvements. (Ord. 2003-017 § 1)

18.48.132 Off-street parking and loading space requirements (sub-area).

A. Vehicle Parking.

1. Commercial. The number of parking spaces required for new commercial structures in the sub-area, except as otherwise noted, shall be 50 percent of the number required by SMC 18.48.050.

2. Residential. One parking space shall be required for each residential unit.

3. Hotels and Motels. One space per room plus additional parking required for ancillary uses per subsection (A)(1) of this section.

B. Loading. Loading spaces shall be provided as required by SMC 18.48.060 except where a public alley is available and may be used in a safe manner as determined by the planning director.

C. Lighting.

1. Adequate lighting must provide for vehicle circulation and pedestrian safety.

2. Freestanding parking lot luminaires shall be located in landscaped islands or otherwise separated from parked or moving vehicles and at a maximum height of 14 feet.

3. Light standards and poles shall be similar in design to those identified in the city's adopted streetscape manual.

4. Wall and canopy lighting shall be screened to keep direct light and glare from spilling off the site.

5. A clear vertical clearance of 15 feet shall be maintained over vehicle movements. (Ord. 2003-017 § 1)

18.48.133 Use of public parking (sub-area).

A. On-street parking and spaces located in public parking lots shall not be reserved or restricted except spaces reserved for use by disabled persons or on which time limits have been set by the city.

B. Nothing in this section is intended to limit voluntary parking management programs established by

business or property owners. (Ord. 2003-017 § 1)

18.48.134 Alternative means of meeting on-site parking requirements (sub-area).

In addition to those alternative means listed in SMC 18.48.080, uses in the town center sub-area may meet the requirements of this code by use of the following:

A. In-Lieu Fee. The required number of on-site spaces for any use may be reduced on a one-for-one basis by payment of an in-lieu-of fee in the amount of \$3,000 per space, or such other fee as the council may adopt by resolution, for use in the development of public parking lots. A document will be recorded that stipulates the number of parking spaces paid. Said space(s) then shall run with the land.

B. Individual joint-use agreements between property owners, within 300 feet of the subject parcel and meeting the requirements of this chapter, may also be prepared to satisfy town center sub-area parking requirements. (Ord. 2003-017 § 1)

18.48.135 Access and design (sub-area).

Access and design of parking lots in the town center sub-area shall be as stipulated for the zoning districts within the town center sub-area. (Ord. 2003-017 § 1)

18.48.140 Special assessment area for maintenance and parking development.

As established by ordinance, a special maintenance and parking development fee shall be assessed for all commercial businesses within the identified geographic area. (Ord. 2003-017 § 1)

18.48.145 Variances.

Except as otherwise allowed by this chapter, applications for variances to the number of parking spaces and design standards required by this chapter shall be made in accordance with Chapter 18.72 SMC, "Variances." (Ord. 2003-017 § 1)

SEQUIM
Draft Chapter
18.23
LAND CLEARING AND GRADING CODE

Sections:

18.23.000 Purposes.
18.23.010 Administering authority.
18.23.020 Permits
18.23.030 Exemptions.
18.23.040 Definitions.
18.23.045 Application requirements.
18.23.050 Performance standards.
18.23.055 Notice.
18.23.060 Appeals.
18.23.065 Bonding.
18.23.070 Violations and penalties.
18.23.075 Public and private redress.
18.23.080 Additional remedies authorized.

18.23.000 Purposes.

This chapter provides regulations for the clearing and grading of a building site and the protection and preservation of trees and associated significant vegetation for the following purposes:

- A. To promote the public health, safety, and general welfare of the citizens of Sequim by preserving the physical and aesthetic character of the city through the prevention of indiscriminate removal or destruction of trees and ground cover on undeveloped or partially developed property;
- B. To implement the policies of the State Environmental Policy Act of 1971 as revised in 1984, and amended thereafter;
- C. To implement and further the goals and policies of the city's comprehensive plan in regard to the environment, open space, critical areas and critical habitats, wildlife habitat, vegetation, resources, surface drainage, watershed, and economics;
- D. To ensure prompt development, restoration and replanting and to establish effective erosion control of property during and after land clearing;
- E. To promote low impact development site planning and building practices that provide for managing surface water runoff on-site and are consistent with the city of Sequim's natural topography, soils, vegetation cover, and hydrology, while protecting its critical shallow aquifers;
- F. To promote land development practices that reduce the amount of site clearing and that result in a minimal adverse disturbance to existing vegetation and soils within the city;
- G. To minimize surface water and ground water runoff and diversion, thereby protecting both the City of Sequim's critical aquifers and adjoining properties;
- H. To aid in the stabilization of soil, and to minimize erosion, sedimentation, and the risk of landslides;
- I. To minimize the need for additional storm drainage facilities caused by the destabilization of soils;
- J. To retain clusters of trees for the abatement of noise and for wind protection;

- K. To acknowledge that trees and ground cover reduce air pollution by producing pure oxygen from carbon dioxide;
- L. To preserve, replace, or enhance the natural qualities of lands, watercourses, riparian corridors and aquatic resources; preserve and protect priority fish and wildlife habitats; minimize water quality degradation and the sedimentation of creeks, streams, ponds, lakes, wetlands, marine waters, and other water bodies; and preserve and enhance beneficial uses;
- M. To promote building and site planning practices that are consistent with the city's natural topographic, hydrologic, soil, and vegetation features while recognizing that certain factors such as condition (e.g., disease, danger of falling, etc.), proximity to existing and proposed structures and improvement, interference with utility services, and the realization of a reasonable enjoyment of property may require the removal and replacement of certain trees and ground cover;
- N. To avoid or minimize impacts of clearing and grading, as a component of land disturbance activities to adjacent and downstream public or private property;
- O. To promote the reasonable development of land in the City of Sequim; while reducing the carbon footprint potential of the developed site;
- P. It is also the purpose of this code to establish a Sequim plans review and site inspection process for larger, potentially more harmful, land disturbing projects to ensure these regulations are met.

18.23.010 Administering authority.

The city's planning director or the Public Works or his/her duly authorized representative is hereby authorized and directed to enforce all the provisions of this chapter.

18.23.020 Permits.

No person shall engage in or cause any land to be cleared without first obtaining a Clearing and Grading Permit, ~~from the planning director or designee.~~ There shall be no clearing on a site for the sake of preparing that site for sale or future development. Trees may only be removed pursuant to a clearing permit which has been approved by the city; and they shall be replaced according to the Landscape Plan.

18.23.030 Exemptions.

Clearing and Grading Permit approval is not required for any of the following activities, provided that clearing and grading activity authorized to be undertaken without a formal approval shall be subject to the minimum requirements contained in 18.23.050 of this ordinance:

We need some more discussion and inputs below --

A. Clearing or grading on a developed single-family lot or partially developed single-family lot of less than 7,0002,250 sf, which is capable of being divided into one additional lot, except for:

1. That portion of the lot that is located in a designated environmentally sensitive area;
2. That portion of the lot that is located within 25 feet of any stream or wetland;
3. That portion of the lot that has slopes exceeding 25 percent;

B. Undeveloped lots of less than 7,0002,250 sf which are not capable of being further subdivided, except for:

1. That portion of the lot that is located in a designated environmentally sensitive area;
2. That portion of the lot that is located within 25 feet of any stream or wetland;
3. That portion of the lot that has slopes exceeding 25 percent;

C. Routine landscape maintenance and gardening;

D. Removal of trees and/or ground cover by the public works department, parks department, fire department and/or public or private utility in situations involving danger to life or property, substantial fire hazards, or interruption of services provided by a utility;

E. Installation and maintenance of public utilities, after approval of the route by the [planning-public works](#) director, [city engineer](#) or designee, except in parks or environmentally sensitive areas;

F. Emergency situations on private property involving danger to life or property or substantial fire hazards;

G. Excavation less than five feet in vertical depth, or fill less than three feet in vertical depth, which cumulatively over time does not involve more than [400-60](#) cubic yards on a single site.

[NOTE: Add a comment about change in contour restrictions.](#)

H. Land clearing, grading, filling, sandbagging, diking, ditching, or similar work during or after periods of extreme weather or other emergency conditions which have created situations such as toxic releases, flooding, or high fire danger that present an immediate danger to life or property.

I. Digging of individual graves in a permitted graveyard.

J. ~~[Refuse disposal sites controlled by other regulations.](#)~~

K. Mining, quarrying, excavation, processing, or stockpiling of rock, sand, gravel, aggregate, or clay where established and provided for by law, provided such operations do not affect the lateral support or increase the stresses in or pressure upon any adjacent or contiguous property.

L. Agricultural crop management of existing and ongoing farmed areas as defined per RCW 84.34.020.

M. Routine drainage maintenance of existing, constructed stormwater drainage facilities located outside of a protected area, including, but not limited to, detention/retention ponds, wetponds, sediment ponds, constructed drainage swales, water quality treatment facilities, such as filtration systems, and regional storm facilities that are necessary to preserve the water quality treatment and flow control functions of the facility. This exemption does not apply to any expansion and/or modification to already excavated and constructed stormwater drainage facilities.

N. Roadway repairs and overlays within public [\[and private streets within city\]](#) street rights-of-way for the purpose of maintaining the pavement on existing paved roadways. This exemption does not apply to curbs, gutters, sidewalks, utilities, new traffic calming devices, new roadways, or the widening of the paved surface of existing roadways.

O. The removal of dead trees or of diseased or damaged trees which constitute a hazard to life or property; [of which removal the City must be notified first.](#)

An exemption from a Clearing and Grading Permit does not exempt the person doing the work from meeting all applicable codes of the City of Sequim.

18.23.040 Definitions.

A. "Best Management or Development Practices (BM/DPs), Best Management Practice (BMP)" shall mean the schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington state.

B. "Buffer or Buffer Zone" shall mean the zone contiguous with a sensitive area that is required for the continued maintenance, function, and structural stability of the sensitive area. The critical functions of a riparian buffer (those associated with an aquatic system) include shading, input of organic debris and coarse sediments, uptake of nutrients, stabilization of banks, interception of line sediments, overflow during high water events, protection from disturbance by humans and domestic animals, maintenance of wildlife habitat, and room for variation of aquatic system boundaries over time due to hydrologic or climatic effects. The

critical functions of terrestrial buffers include protection of slope stability, attenuation of surface water flows from stormwater runoff and precipitation, and erosion control.

C. "Caliper" shall mean the diameter of any tree trunk as measured at a height of four feet above the ground on the upslope side of the tree.

D. "Creek" shall mean those areas where surface waters flow sufficiently to produce a defined channel or bed. A defined channel or bed is indicated by hydraulically sorted sediments or the removal of vegetative litter or loosely rooted vegetation by the action of moving water. The channel or bed need not contain water year around. This definition is not meant to include storm water runoff devices or other entirely artificial watercourses unless they are used to store and/or convey pass-through stream flows naturally occurring prior to construction.

E. "Clearing" shall mean the act of cutting and/or removing vegetation. This definition shall include grubbing vegetation.

F. "Clearing and Grading Permit" shall mean the written approval of the city of Sequim planning director, [public works director](#) or designee to proceed with the act of clearing property within the city limits of Sequim. The Clearing and Grading Permit includes the associated approved plans and any conditions of approval as well as the permit form itself.

G. "Critical Area" shall mean any area designated as a critical area pursuant to RCW 36.70A.170 and Chapter 18.10 SMC, [Chapters 18.70 and 18.80 SMC](#).

H. "Degradation" shall mean degradation of an area includes, but is not limited to, impacts such as sedimentation, erosion, and loss of shading, light and noise [pollution](#).

I. "Developed lot" shall mean a lot or parcel of land upon which a structure(s) is located, which cannot be more intensively developed pursuant to the city zoning code, and which cannot be further subdivided pursuant to city subdivision regulations.

J. "Development" shall mean any activity that requires federal, state, or local approval for the use or modification of land or its resource. These activities include, but are not limited to: [all major](#) subdivision and [short minor](#) subdivisions; binding site plans; planned unit developments; variances; shoreline substantial development; clearing activity; excavation; embankment; fill and grade work; converting fallow land or undeveloped land to agricultural purposes; activity conditionally allowed; building or construction; revocable encroachment permits; [rights of way alterations](#) and septic approval.

K. "Development Area" shall mean an area where the movement of earth, or a change in the existing soil cover (both vegetative and nonvegetative) and/or the existing soil topography occurs as a result of an applicant's development plans.

L. "Drainage Plan" shall mean a plan for receiving, handling, [retaining, storing](#) and transporting surface water or groundwater runoff within the site, [and off as required](#).

M. "Drip line" of a tree shall be described by a line projected to the ground delineating the outermost extent of foliage in all directions.

N. "Dry Season" shall mean the months of [May-April](#) through September, [or as defined by the Instream Flow Rule established for WRIA 18 \(Dungeness River Watershed\)](#).

O. "Ecology" shall mean Washington State Department of Ecology.

P. "Engineered Fill" shall mean soil fill, which is wetted or dried to near its optimum moisture content, placed in lifts of 12 inches or less and each lift compacted to a minimum percent compaction as specified by a geotechnical engineer.

Q. “Erosion” shall mean the wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. Also, the detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion:

1. Accelerated erosion – Erosion much more rapid than normal or geologic erosion, primarily as a result of the influence of the activities of humans or, in some cases, of the animals or natural catastrophes that expose bare surfaces (e.g., fires).
2. Geological erosion – The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, building up of floodplains, coastal plains, etc. Synonymous with natural erosion.
3. Gully erosion – The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from one (1) to two (2) feet to as much as seventy-five (75) to one hundred (100) feet.
4. Natural erosion – Wearing away of the earth’s surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by humans. Synonymous with geological erosion.
5. Normal erosion – The gradual erosion of land used by humans, which does not greatly exceed natural erosion.
6. Rill erosion – Erosion processes in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils.
7. Sheet erosion – The removal of a fairly uniform layer of soil from the land surface by runoff.
8. Splash erosion – The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff.

R. “Excavation” shall mean the removal of material such as earth, sand, gravel, rock, or asphalt; and the vegetative materials above or on.

S. “Fill” shall mean Earth, sand, gravel, rock, asphalt, or other solid material used to increase the ground surface elevation or to replace excavated material; and that can be compacted for structural uses.

T. “Filling” shall mean the act of placing fill material (earth, sand, gravel, rock, asphalt, or other solid material) on any soil surface, natural vegetative covering, or other fill material to raise the ground elevation or to replace excavated material.

U. “Geotechnical Engineer” shall mean a professional engineer currently registered in the state of Washington, qualified by reason of experience and education in the practice of geotechnical engineering, and designated by the owner as the geotechnical engineer of record for the project.

V. “Grading” shall mean the movement of earth and vegetative material through mechanical or other means to create the finished surface and contour of a project site.

W. “Grubbing” shall mean the act of removing vegetation by the roots.

X. “Ground cover” shall mean a dense covering of small plants such as salal, ivy, ferns, mosses, grasses, or other types of vegetation which normally cover the ground.

Y. “Impervious Area” shall mean a hard surface area (e.g., parking lot or rooftop) that prevents or impedes the entry of water into the soil, thus causing water to run off the surface in greater quantities or at an increased rate of flow.

NOTE: Need to add definition for “Irrigation ditches, channels canals or tight lines (piping)”.

Z. “Lakes” shall mean natural or artificial bodies of water of two or more acres and/or where the deepest part of the basin at low water exceeds two meters (6.6 feet). Artificial bodies of water with a recirculation system approved by the public works department are not included in this definition.

AA. “Land development permit” shall mean a preliminary or final plat for a ~~single-family~~ residential development; a building permit; site plan; preliminary or final planned unit development plan.

BB. “Land Disturbance Activity” shall mean any activity that results in movement of earth, or a change in the existing soil cover and/or the existing soil topography. Land disturbing activities include, but are not limited to, clearing, grading, filling, and excavation.

CC. “Low Impact Development (LID)” shall mean a stormwater management strategy and methodologies that emphasizes conservation and use of existing natural site features, including contours integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns in residential, commercial, and industrial settings.

DD. “Mechanical equipment” shall mean all motorized equipment used for earth moving, trenching, excavation, gardening, landscaping, farming, transporting and general property maintenance exceeding 12 horsepower in size.

EE. “Native growth area” shall mean a restrictive area where all native, predevelopment vegetation shall not be disturbed or removed except for removal pursuant to an enhancement program approved pursuant to this chapter or to remove dead or diseased vegetation. The purpose of the area is to protect steep slopes, slopes with erosion potential, landslide and seismic hazards, creeks, wetlands and/or riparian corridors, wildlife, and areas shown on the environmentally sensitive areas map. This area shall be defined during the development review process and shown on the recorded plat, short plat or approved site plan.

FF. “Open Space” shall mean land set aside for public or private use within a development that is not built upon, but may include pathways and trail systems.

GG. “Partially developed lot” shall mean a lot or parcel of land upon which a structure (refer to SMC Chapter 18.08) is located and which is of sufficient area so as to be capable of accommodating additional development pursuant to the Sequim zoning code; or which may be subdivided in accordance with the city of Sequim subdivision or planned unit development chapters.

HH. “Permeable” shall mean soil or other material that allows the infiltration or passage of water or other liquids.

II. “Permit” shall mean, unless otherwise noted, the Clearing and Grading Permit; see Clearing and Grading Permit.

NOTE: Add definition for “Pervious Materials”

JJ. “Removal” shall mean the actual destruction or causing the effective destruction through damaging, poisoning or other direct or indirect actions resulting in the death of a tree or ground cover. NOTE: Needs wordsmithing.

KK.

NOTE: Add definition for “Right of Way Permit”

~~KK.LL.~~ “Rockery or Rock Wall” shall mean one or more courses of large rocks stacked near vertical in front of an exposed soil face to protect the soil face from erosion and sloughing. NOTE: Add sentence re retaining walls.

~~LL.MM.~~ “Routine landscape maintenance” shall mean pruning, weeding, planting ~~annuals~~, mowing ~~turf lands~~ and ground cover management which is undertaken by a person in connection with the normal maintenance and repair of vegetated property. This definition does not include felling or topping of trees or removal of invasive plants resulting from lack of regular maintenance.

~~MM.NN.~~ “Runoff” shall mean water from rain, melted snow, or irrigation that naturally flows over the land surface.

~~NN.OO.~~ “Sedimentation” shall mean the process of gravity-induced settling and deposition of fragmented rock, soil, or organic particles displaced, transported, and deposited by erosive water-based processes.

PP.

NOTE: Add definition for “Site Development Inspection”

NOTE: Add definition for "Site Development Permit"

~~QQ-QQ~~. "Stormwater Pollution Prevention Plan" shall mean a report containing a narrative and drawings used to explain and justify the pollution prevention decisions made for a particular project. The narrative contains concise information concerning existing site conditions, construction schedules, and other pertinent items that are not contained on the drawings. The drawings and notes describe where and when the various BMPs should be installed, the performance the BMPs are expected to achieve, and actions to be taken if the performance goals are not achieved.

~~PP-RR~~. "Stormwater Site Plan" shall mean a comprehensive report (including maps and drawings as necessary) containing all of the technical information and analysis necessary for the City of Sequim to evaluate a proposed new development or redevelopment project for compliance with stormwater requirements. Contents of the stormwater site plan will vary with the type and size of the project, and individual site characteristics.

~~QQ-SS~~. "Tree" shall mean any living woody plant characterized by one main stem or trunk and many branches and having a caliper of six-eight inches or greater, or a multi-stemmed trunk system with a definitely formed crown. NOTE: In no case may a Garry Oak be removed without first notifying City, and receiving written approval from public works director.

~~RR-TT~~. "Undeveloped or Under-utilized lot" shall mean a platted lot or parcel of land upon which no structure exists; or a lot that has structures but still has development potential.

~~SS-UU~~. "Wetlands" shall mean those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar area.

~~TT-VV~~. "Wetponds" (also known as constructed wetlands) shall mean drainage facilities for water quality treatment that contain permanent pools of water that are filled during the initial runoff from a storm event. They are designed to optimize water quality by providing retention time in order to settle out particles of fine sediment to which pollutants such as heavy metals absorb. They also allow biologic activity to occur that metabolizes nutrients and organic pollutants.

~~UU-WW~~. "Wet Season" shall mean the period of the year between October 1 and ~~April 30~~March 31.

18.23.045 Application requirements.

A. An application for a Clearing and Grading Permit shall be submitted by the applicant and stamped by aa professional engineer licensed in the State of Washington on a form provided by the city, together with a site plan and other information as described hereafter:

1. Name, address and telephone number of the applicant;
2. Legal status of applicant with respect to the land;
3. Written consent of owner(s) of the land, if the applicant is not the sole owner;
4. Name of person preparing the map, drawing or diagram submitted with the application, along with credentials if applicable;
5. Location of the property, including street number and addresses, together with the names and addresses of all the adjacent property owners within 80 feet of the subject property as listed in the records of the Clallam County assessor;
6. A site plan of the property, drawn to scale, depicting the following items (scale 1" = 30' or as approved by the planning director):
 - a. Topographic information,
 - b. Proposed grades,
 - c. Location of all existing and/or proposed structures, driveways, and utilities,
 - d. Areas proposed for clearing and the proposed use for such area,
 - e. Designation of all diseased or damaged trees,
 - f. Any proposed grade changes that might adversely affect or endanger trees on the property and specifications to maintain them.

- g. Designation of trees to be removed and trees to be maintained,
- h. Designation of all wetlands, streams and environmentally sensitive areas;
- 7. A statement outlining the purpose of the tree removal (e.g., building construction, street or roadway, driveway, recreation area, patio, or parking lot), and the replacement schedule for those trees removed, together with a proposed timetable for when the work will occur;
- 8. The manner in which the cleared areas on the property will be reclaimed with vegetation and the timetable for replanting;
- 9. Any other information deemed necessary by the city to allow adequate review and implementation in conformance with the purposes of this chapter.
- 10. Identification of areas to be revegetated and/or restored. Provide plant types and methods.
- 11. Location and dimensions of buffer areas to be maintained or established
- 12. Location and description of proposed erosion-control devices or structures consistent with submittal requirements found in this Chapter.

B. Upon receipt of the application for a Clearing and Grading Permit, the staff shall inspect the site and contiguous properties. If the staff determines that the plan is in compliance with the provisions of this section and will result in the removal of no more trees (and has a tree replacement schedule) or vegetation than is necessary to achieve the proposed development, the permit shall be approved under the provisions of Title 20, SMC, C Chapter XX (Staff Decision – Optional Hearing).

The city may require a modification of the clearing plan or the associated land development plan to ensure the retention of the maximum number of trees, and any other vegetation that has been listed in the Comprehensive Plan as “vegetation of significance (ie: Sequim Cactus).

If the staff determines that the plan will result in the destruction of more trees and vegetation than is reasonably necessary to achieve the proposed development, and there is no tree replacement plan the permit shall be denied.

C. Any permit granted under the provisions of this section shall expire one year from the date of issuance. No work may commence on the permit until the appeal time limit has expired. Upon receipt of a written request, a permit may only be extended once for six months. Thereafter a new clearing and grading plan and permit application must be submitted.

D. Approved plans shall not be amended without written authorization from the city. The permit may be revoked or suspended by the city upon discovery that incorrect information was supplied or upon any violation of the provisions of this chapter.

E. Applications for land clearing shall be referred to other city departments or agencies for review and approval as deemed necessary by the planning director or the public works director; and in all cases shall be reviewed by the city engineer.

F. If the grading involves 500-60 or more cubic yards, a SEPA (State Environmental Policy Act) review shall be required. Refer to Subsection 18.23.045.K.

G. When new, replaced, or new plus replaced impervious surfaces total 2,000 square feet or more, or disturb 72,000 square feet or more of land, a Construction Stormwater Pollution Prevention Plan (SWPPP) shall be submitted as part of the Stormwater Site Plan. The SWPPP shall:

- 1. Include a narrative and drawings with maps.
- 2. Clearly reference all BMPs in the narrative and marked on the drawings.
- 3. Include documentation to explain and justify the pollution prevention decisions made for the project.
- 4. Include sediment and erosion control BMPs consistent with the BMPs contained in chapters 3 and 4 of Volume II of the *Stormwater Management Manual for Western Washington-2005* (or as amended), and/or other equivalent BMPs contained in technical stormwater manuals approved by the Washington State Department of Ecology.

H. No work shall commence until a permit notice is posted by the City of Sequim on the subject site for a period of ten (~~10~~14) days prior to commencement of grading activities.

I. The planning director, public works director or city engineer or designee may impose conditions on permit approval as needed to mitigate identified project impacts and shall deny permit applications that are inconsistent with the provisions of this chapter.

J. All clearing and grading projects shall be subject to the following conditions:

1. All clearing and grading, as a component of land disturbance projects, shall be subject to inspection by the city of Sequim.
2. Prior written permission from the planning-public works director or the city engineer shall be provided for modification of any plan.
3. The applicant shall maintain an up-to-date, approved copy of the plans on-site; and provide the city with as-built drawings when project is completed.
4. The applicant shall provide owner permission for city of Sequim staff to enter the site for purposes of inspecting compliance with the plans, for performing any work necessary to bring the site into compliance with the plans, or for emergency corrective measures.

K. When a SEPA environmental checklist is required:

1. A determination of non-significance (DNS), a mitigated determination of non-significance (MDNS), or a determination of significance (DS) shall be issued by the city of Sequim environmental official or planning director, prior to the issuance of a clearing and grading approval by the public works director.
2. Provisions contained in the DNS, MDNS, or DS shall be considered when approving the clearing and grading activity and conditions of the approval shall not be less restrictive than those in the DNS, MDNS, or DS.

L. All projects applying for a Clearing and Grading Permit shall be required to fulfill the native vegetation standards set forth in 18.22 SMC.

18.23.050 Performance standards. All of the performance standards in this section are required unless an exemption from a particular standard is clearly justified in the narrative of the construction SWPPP, and approved by the public works director or city engineer.

A. Minimize Potential Impacts

All grading and clearing activities shall be conducted so as to minimize potential adverse effects of these activities on forested lands, surface water quality and quantity, groundwater recharge, fish and wildlife habitat, adjacent properties, and downstream drainage channels. The applicant shall attempt to prevent impacts and minimize the clearing of naturally occurring vegetation, retain existing soils, and maintain the existing natural hydrological functions of the site.

B. Stormwater Consistency of Standards

All standards under this code will be consistent with the latest adopted version of the *Stormwater Management Manual for Western Washington-2005*, pursuant of Title 13.400 SMC.

C. Clearing and Grading and Land Disturbance Limits

Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval, site plan approval, etc.) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing clearing and grading areas, consideration ~~should~~shall be given to minimizing removal of existing trees and minimizing disturbance/compaction of native soils except as needed for building purposes. Clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas shall be delineated on the site plans and the development site.

Prior to beginning land disturbing activities, including clearing and grading, all clearing limits, sensitive areas, critical areas and their buffers, and trees that are to be preserved within the construction area shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.

D. Natural Features and Vegetation Retention

Vegetation, drainage, duff layer, native top soil, and other natural features of the site ~~should~~ shall be preserved, and the grading and clearing be performed in a manner that attempts to limit areas of impact to the development area (e.g., structures, roads, utilities, sidewalks, parking, landscaping, etc.). Groundcover and tree disturbance shall be minimized, and root zones shall be protected. Land disturbance activities shall be conducted so as to expose the smallest practical area to erosion for the least possible time. Projects shall be phased to the maximum degree practical and shall take into account seasonal work limitations, to decrease exposed soils and minimize adverse impacts to natural features and vegetation resulting from land disturbance activities. No ground cover or trees which are within a minimum of fifteen (15) NOTE: These set backs need to conform to our buffers, critical areas and open space set backs. feet of the annual high water mark of creeks, streams, lakes, and other shoreline areas or within ten (10) feet of the top of the bank of the same shall be removed, nor shall any mechanical equipment operate in such areas, provided that conditions deemed by the planning-public works director, city engineer or designee to constitute a public nuisance may be removed, and provided that a property owner shall not be prohibited from making landscaping improvements where such improvements are consistent with the aims of this section, and where the owner can convincingly demonstrate such consistency to the planning-public works director, city engineer or designee.

E. Aesthetics

Land disturbance activity shall be undertaken in such a manner so as to preserve and enhance the city of Sequim's aesthetic rural character. Important landscape characteristics that define ~~the this~~ aesthetic rural character, such as large landmark trees, important vegetation species, and unique landforms or other natural features shall be preserved to every extent practical.

F. Site Containment

Erosion, sediment, and other impacts resulting from any clearing and grading activity shall be contained on the site. Containment of such impacts ~~may~~ shall require temporary erosion/ sedimentation control measures during and immediately following all clearing and grading activities. The faces of slopes shall be prepared and maintained to control erosion. Check dams, riprap, plantings, terraces, diversion ditches, sedimentation ponds, straw bales, or other devices or methods shall be employed where necessary to control erosion and provide safety. Devices or procedures for erosion protection shall be initiated or installed as soon as possible during grading operations and shall be maintained in operable condition by the owner. These erosion control systems or devices shall be removed at the time the project is ready for its intended occupancy and the last of the landscaping has been completed.

G. Protection of Adjacent and Downstream Properties and Waterways

Downstream properties and waterways shall be protected from erosion during construction due to temporary increases in the volume, velocity, and peak flow rate of runoff from the site. Downstream analysis is necessary if changes in flows could impair or alter conveyance systems, stream banks, bed sediments or aquatic habitat. Where necessary to protect waterways and properties, stormwater retention or detention facilities shall be constructed as one of the first steps in grading. Detention facilities shall be functional prior to construction of site improvements (e.g., impervious surfaces). If permanent infiltration ponds are used for flow control during construction, these facilities ~~should~~ shall be maintained to ~~protected~~ from siltation during the construction phase.

H. Install Sediment Controls

Stormwater runoff from disturbed areas shall pass through a sediment pond, or other appropriate sediment removal BMP prior to entering a storm drain inlet, leaving a construction site, or discharging to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but shall meet the flow control performance standard of Chapter 13.404-404 SMC. Sediment removal BMPs (sediment ponds, traps, filters, etc) shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place. BMP's intended to trap sediment on-site

shall be located in a manner to avoid interference with the movement of juvenile salmonids, ~~attempting to enter off-channel areas or drainages.~~ If protection is inadequate and deposition occurs on the adjoining property, public right-of-way, or drainage system, the contractor shall immediately remove the deposited sediment and restore the affected area to its original condition.

I. Construction Access

Construction vehicle access shall be, whenever feasible, limited to one route. A temporary access road shall be provided at all sites. Access surfaces shall be stabilized to minimize the tracking of sediment onto adjacent roads by utilizing quarry spalls, crushed rock or other equivalent BMPs. Other measures may be required at the discretion of the ~~planning-public works~~ director, ~~city engineer~~ or designee in order to ensure that sediment is not tracked onto public streets by construction vehicles, or washed into storm drains. All approach roads shall be kept clean. Wheel wash or tire baths shall be located on site if the stabilized construction entrance is not effective in preventing sediment from being tracked onto public roads. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner. If sediment is tracked off site, public roads shall be cleaned thoroughly at the end of each day, or more frequently during wet weather. Street wash wastewater shall be controlled by pumping back on-site or otherwise be prevented from discharging into systems that are tributary to state surface waters.

J. Stabilization of Disturbed Areas

All exposed soil shall be stabilized by application of suitable BMPs and soil stabilization measures, including but not limited to sod or other vegetation, ~~geo-textiles~~, plastic covering, mulching, ~~hydro-seeding~~ or application of base course(s) on areas to be paved. Soil stabilization measures selected should be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters or ground water. Soils shall be stabilized at the end of the shift before a holiday or weekend ~~if as~~ needed based on the weather forecast. All BMPs shall be selected, designed, and maintained according to the approved manual, as designated by the ~~planning-public works~~ director, ~~city engineer~~ or designee. ~~From October 1 through April 30, no No~~ unworked soils shall remain exposed for more than two days. ~~From May 1 through September 30, no unworked soil shall remain exposed for more than seven days.~~ Soil stockpiles must be stabilized from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways and drainage channels. Linear construction activities, including right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall be conducted to meet the soil stabilization requirement.

K. Dust Suppression

Dust from clearing, grading, and other construction activities shall be minimized at all times. Impervious surfaces on or near the construction area shall be swept, vacuumed, or otherwise maintained to suppress dust entrainment. Any dust suppressants used shall be approved by the ~~planning-public works~~ director, ~~city engineer~~ or designee. Petrochemical dust suppressants are prohibited. Watering the site to suppress dust ~~is also prohibited~~ must be approved by public works director, city engineer or designee unless and shown that it can be done in a way that keeps sediment out of the drainage system.

L. Erosion and Sedimentation Control

Erosion and sedimentation control BMPs shall be designed and implemented appropriate to the scale of the project and necessary to prevent sediment from leaving the project site, including but not limited to, the standards and requirements described in this chapter, and in the current edition of the *Stormwater Management Manual for Western Washington*.

1. In addition to the measures in this and other codes and ordinances, the ~~public works director, city engineer~~ ~~planning director~~ or designee may impose the following erosion control measures, or other additional measures, as appropriate for the project:
 - a. Performance monitoring to determine compliance with state water quality standards, or more stringent standards if adopted by the city.
 - b. Funding additional city inspection time, up to a full-time inspector.
 - c. Stopping work if necessary to control erosion and sedimentation.
 - d. Construction of additional siltation/sedimentation ponds

- e. Use of erosion control blankets, nets, or mats in addition to or in conjunction with straw mulch.
2. If the initially implemented erosion and sedimentation BMPs do not adequately control erosion and sedimentation, additional BMPs shall be installed, including but not limited to the extraordinary BMPs described in subsection (1) of this section. It is the contractor's responsibility to ensure sediment does not leave the site in an amount that would violate applicable state, county, or city water quality standards. The city of Sequim has the authority to enforce state water quality standards, or, if-as adopted by the city of Sequim, more stringent water quality standards.
3. The timing/sequencing requirements for implementing/removing erosion and sedimentation control measures are as follows:
 - a. The contractor must install sediment removal BMPs prior to all-any other clearing, grading, or construction. These BMPs must be functional before other land disturbing activities take place.
 - b. The contractor must remove all temporary erosion and sediment control BMPs within thirty (30) days after final site stabilization or after the BMP is no longer needed, per agreement of the public works director, city engineer or designee~~planning director or designee~~. Before removing such BMPs, the contractor must remove trapped sediment or stabilize on-site. Any soils disturbed during sediment removal must be permanently stabilized by the contractor.
 - c. The contractor must complete the required permanent erosion control within seven (7) days of completed grading unless the weather is unsuitable for transplanting. In that case, the contractor must maintain temporary erosion control until permanent restoration can be completed. The period between work completion and final planting shall not exceed one year without written authorization from the public works director, city engineer or designee~~planning director or designee~~.

M. Native Soil Protection and Amendment

1. The duff layer and native topsoil should-shall be retained in an undisturbed state to the maximum extent practicable. In areas requiring grading, remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas, to be reapplied to other portions of the site where feasible.
2. Soil quality and depth. All areas subject to clearing and grading that have not been covered by impervious surface, incorporated into a drainage facility or engineered as structural fill or slope shall, at project completion, shall demonstrate compliance with the "Guidelines for Implementing Soil Quality and Depth" (BMP T5.13 in the *Stormwater Management Manual for Western Washington-2005, or as amended*).

N. Stabilize Channels and Outlets

Temporary on-site stormwater conveyance systems shall be designed, constructed, and stabilized to prevent erosion from leaving the site and impacting properties, streams, and wetlands downstream of the clearing and grading activity. Stabilization measures shall be provided which comply with local BMPs at stormwater conveyance system outlets to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches or properties.

All temporary on-site conveyance channels shall be designed, constructed and stabilized to prevent erosion from the expected peak 10 minute velocity of flow from a Type 1A, 10- year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis shall use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas outside the project site, the analysis shall use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. Bare soil areas should-shall be modeled as "landscaped area" or as an area employing LID methods.

Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches shall be provided at the outlets of all conveyance systems.

NOTE: Permitting for such [from other agencies] must be discussed here.

O. Protection of Critical Areas

The function and values of all critical areas, including all stream types, geologically unstable areas, critical aquifer recharge areas, frequently flooded areas, wetlands, and fish and wildlife conservation areas or habitats, and their critical areas buffers located on or adjacent to the site shall be protected from clearing and grading activities that result in sedimentation, erosion, and degradation. Such impacts shall be avoided by appropriate use of setbacks, erosion, and sediment control measures and other appropriate best development and management practices consistent with Chapters [18.70 and 18.80 SMC](#).

P. Avoidance of Hazards

Land disturbance activities shall not result in off-site physical damage, nor pose a danger or hazard to life or property. Neither shall such activities contribute to or create landslides, accelerated soil creep, or settlement of soils. [NOTE: This seems to be redundant!](#)

Q. Cut and Fill Slopes

Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion, [and match contours as much as possible](#). In addition, slopes shall be stabilized in accordance with the requirements of this section. The applicant shall:

1. Submit a geotechnical report, prepared by a geotechnical engineer, when required pursuant to the City of Sequim's Land Use Code including Critical Area Ordinance provisions for qualified professional reports or clearing and grading development standards. The clearing and grading development standards specify when a subsurface investigation is required and the level of investigation and information required in the report.
2. Minimize clearing and grading on slopes fifteen (15) percent or greater and meet any sensitive earth conditions performance standards set forth in Chapter 18.80 SMC.
3. Comply with the Land Use Code [\(NOTE: Whose LU Code? Need SMC reference here.\)](#) restrictions applicable to slopes forty (40) percent or greater and to areas of colluvial or landslide deposit on slopes of fifteen (15) percent or greater.
4. Limit the maximum gradient of artificial slopes to no steeper than 2:1 [two (2) feet of horizontal run to one (1) foot of vertical fall] unless a geotechnical engineering report and slope stability analysis is provided and shows that a factor of safety of at least 1.5 for static loads and 1.1 for pseudostatic loads can be met, as demonstrated per the methodology in the clearing and grading development standards.
5. Do no clearing, excavation, stockpiling, or filling on the potential slide block of an unstable or potentially unstable slope unless it is demonstrated to the [public works director, city engineer or designee](#) ~~planning director's~~ satisfaction that the activity would not increase the load, drainage, or erosion on the slope.
6. Do no clearing, excavation, stockpiling, or filling on any unstable or potentially unstable areas (such as landslide deposits) unless it is demonstrated to the [public works director, city engineer or designee](#) ~~planning director's~~ satisfaction that the activity would not increase the risk of damage to adjacent property or natural resources or injury to persons.
7. Intercept any ground water, subsurface water, or surface water drainage encountered on a cut slope and discharge it at a location approved by the [public works director, city engineer or designee](#) ~~planning director in consultation with the city of Sequim utilities department~~. Off-site stormwater (run-on) or groundwater shall be diverted away from slopes and undisturbed areas with interceptor dikes, pipes and/or swales. Off-site stormwater ~~should~~ [shall](#) be managed separately from stormwater generated on the site.
8. Follow the procedures and standards in the clearing and grading development standards related to slopes.
9. Design and protect cut and fill slopes to minimize erosion.
10. Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
11. Check dams shall be placed at regular intervals within constructed channels that are cut down a slope.
12. At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion. Temporary pipe slope drains shall handle the expected peak 10-minute flow velocity

from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis shall use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis shall use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. Bare soil areas should be modeled as “landscaped area, or as a LID area.”

R. Rockeries

Rockeries may be used for erosion protection of cut or fill slopes. The primary function of a rockery is to protect the steep slope face from soil erosion and sloughing. Rockerries shall be consistent with the International Building Code (IBC) Regulations.

1. Rockeries used to protect uncontrolled fill slopes may be no higher than four (4) feet, as measured from the bottom of the base rock.
2. Rockeries used to protect cut slopes or reinforced or engineered fill slopes may be up to a maximum height of twelve (12) feet, as measured from the bottom of the base rock, with the approval of the planning director or designee. Any rockery that is over four (4) feet high, as measured from the bottom of the base rock (cut slopes and reinforced or engineered fill slopes only) shall be designed by a geotechnical engineer.
3. A wall drain must be provided for all rockeries greater than four (4) feet in height as measured from the bottom of the base rock. The drains shall be installed in accordance with applicable standards from the latest edition of the *Stormwater Management Manual for Western Washington*.
4. The geotechnical engineer must provide construction monitoring and/or testing as required by the permit conditions, and submit construction inspection reports to the public works department or the city engineer for all rockeries that require design by a geotechnical engineer. For each project, or phase of a project, the geotechnical engineer must provide a final letter or report summarizing the results of the construction monitoring for each rockery, verifying that the rockery construction meets the geotechnical recommendations and design guidelines. The final letter or report must be submitted for approval to-by the City public works director, city engineer or designee prior to the final clearing and grading inspection.

S. Control of Other Pollutants

Construction site operators ~~must~~ shall properly handle and dispose of other pollutants that are on-site during construction so as to avoid possible health risks or environmental contamination. Direct and indirect discharge of pollutants to the drainage system, critical areas, wetlands, streams, or any other adjacent properties is prohibited.

1. All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater.
2. Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks shall include secondary containment.
3. Maintenance, fueling and repair of heavy equipment and vehicles shall be conducted using spill prevention and control measures. Contaminated surfaces shall be cleaned immediately following any spill incident.
4. Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system or to the sanitary sewer with ~~local sewer district~~ the city engineer's approval.
5. Application of fertilizers and pesticides shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' label requirements for application rates and procedures shall be followed.
6. BMPs shall be used to prevent or treat contamination of stormwater runoff by pH modifying sources. These sources include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters. Construction site operators shall adjust the pH of stormwater if necessary to prevent violations of water quality standards, and shall notify the city when they are required to do such adjustment.

7. Construction sites with significant concrete work shall adjust the pH of stormwater if necessary to prevent violations of water quality standards. Construction site operators shall obtain written approval from the Department of Ecology prior to using chemical treatment other than CO₂ or dry ice to adjust pH, and provide a copy of such approval to the city.

T. Dewatering Devices

1. Foundation, vault, and trench dewatering water which have similar characteristics to stormwater runoff at the site shall be discharged into a controlled conveyance system prior to discharge to a sediment pond. Channels must be stabilized (as specified in Element #8 of Ecology's *Stormwater Management Manual for Western Washington*, Volume 2 or as amended).
- ~~2. Clean, non-turbid dewatering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, provided the dewatering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through stormwater sediment ponds.~~
- ~~3.2. Highly T~~urbid or contaminated dewatering water shall be handled separately from stormwater.
- ~~4.3.~~ Other disposal options, depending on site constraints, may include:
 - a. Infiltration.
 - b. Transport off site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.
 - c. On-site treatment using chemical treatment or other suitable treatment technologies.
 - d. Sanitary sewer discharge with local sewer district~~city engineer~~ approval.
 - e. Use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

U. Slash Removal

Slash from clearing shall preferably be chipped and spread across the site within one (1) year of project completion. ~~If necessary, burning of slash may be permitted based on local regulatory, climatic, and site conditions.~~

V. Re-vegetation

The site shall be revegetated and landscaped as soon as practical, in accordance with a revegetation plan and the tree replacement plan, approved by the public works director, city engineer or designee~~planning director or designee.~~

1. A permanent revegetation plan, utilizing vegetation that is known to have a high natural survival rate, shall be implemented consistent with Sequim climate and landscaping, tree protection and replacement, and permanent revegetation regulations.
2. Where permanent revegetation measures are not in place within seven (7) days in the dry season and two (2) days in the wet season, the applicant shall provide temporary revegetation or stabilization measures in accordance with the recommendations of the latest edition of Ecology's *Stormwater Management Manual for Western Washington*, and maintain such measures in good condition until the permanent revegetation measures are installed and inspected by the City of Sequim.
 - a. Temporary revegetation during the dry season for all disturbed areas of the site (exposed and unworked) that are not covered by permanent improvements such as buildings, parking lots, and decks shall be hydro-seeded and irrigated within seven (7) days until vegetation has been successfully established or the site otherwise revegetated or stabilized using straw mulch, or other approved methods on an interim basis.
 - b. Temporary revegetation during the wet season for disturbed areas of the site (exposed and unworked) that are not covered by permanent improvements such as buildings, parking lots, and decks shall be hydro-seeded, otherwise revegetated, or stabilized using plastic sheeting or other approved methods, on a temporary basis within two (2) days until vegetation has been successfully established.

W. Construction Phasing NOTE: Seems redundant

Development projects shall phase land disturbance to the maximum degree practicable and shall take into account seasonal work limitations as explained in Section X. Construction SWPPP's shall indicate land

clearing schedules intended to minimize the occurrence and extent of land disturbing activities in the wet season. Each phase of land disturbance shall comply with the requirements of this code.

X. Seasonality – Temporary Restrictions

Seasonality refers to the wet season (defined as the period from October 1 through ~~April 30~~March 31). Clearing, grading, and other land disturbing activities may be approved by the public works director, city engineer or designee~~planning director or designee~~ for proposals that have minimal disturbance of soils and are on sites with predominant soils that have low runoff potential, and are not hydraulically connected to sediment/erosion-sensitive features. The following criteria also apply:

1. Wet season clearing, grading, and other land disturbing activities may be approved provided an erosion and sediment control plan is prepared by a professional engineer or a licensed geo-technical specialist that specifically identifies methods of erosion control for wet weather conditions to control erosion/sedimentation, surface water run off, and safeguard slope stability. In a situation where erosion or sediment is not contained on site, construction activity shall cease immediately and notification of the public works director, city engineer or designee~~planning director~~ shall be made within twenty-four (24) hours.
2. When approval is issued in the dry season (defined as the months of ~~May~~April through September), and work is allowed to continue in the wet season, the city of Sequim may require additional measures to limit erosion/sedimentation for slope stability. The public works director, city engineer or designee~~planning director or designee~~ may prohibit land-disturbing activities during certain days of the wet season. Determinations shall be made on a site-specific basis and evaluation of the following:
 - a. Average existing slope on the site.
 - b. Quantity of proposed cut and/or fill.
 - c. Classification of the predominant soils and their erosion and runoff potential.
 - d. Hydraulic connection of the site to features that ~~are~~is sensitive to erosion impacts.
 - e. Storm events and periods of heavy precipitation.
3. If a clearing and grading approval is issued for work during the wet season and the public works director, city engineer or designee~~planning director~~ subsequently issues a "Stop Work" order or correction notice for insufficient erosion and sedimentation control, the approval will be suspended until the dry season, or until the public works director, city engineer or designee~~planning director~~ determines that weather conditions are favorable and effective erosion and sedimentation control is in place.
4. Certain activities are exempted from seasonal restrictions (For a list of exemptions, see *Stormwater Management Manual for Western Washington-2005*, Construction SWPPP, Vol. 2 or as amended).
5. The following activities are exempt from the seasonal clearing and grading limitations:
 - a. Routine maintenance and necessary repair of erosion and sediment control BMPs;
 - b. Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
 - c. Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

Y. Maintenance NOTE: Could be combined in the earlier design and development/construction stages.

All temporary and permanent erosion and sediment control devices shall be maintained and repaired as needed. Erosion and sediment control devices that are damaged or not working properly shall be returned to operating condition within twenty-four (24) hours of identifying they are not working properly or receiving notice from the city of Sequim, or as otherwise directed by the public works director, city engineer or designee~~planning director~~. The contractor shall:

1. Regularly inspect (weekly and within 24 hours after any runoff producing storm event during the dry season, and daily including on weekends during the wet season) all temporary and permanent erosion and sedimentation BMPs and maintain them per the development standards so that they function as intended until the site has been permanently stabilized, and the potential for on-site erosion has passed. Inlets should be inspected weekly at a minimum and daily during storm events. Inlet protection devices should be cleaned or removed and replaced when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

2. Return any BMPs that are damaged or not working properly to normal operating conditions as directed by the city or within twenty-four (24) hours of receiving notice from the [public works director, city engineer or designee](#)~~planning director or designee~~. BMPs that must be addressed include: stream buffers/setbacks, stormwater/pollutant protection, natural feature preservation/vegetation retention, critical area protection, setbacks/buffers, wetlands, fish habitat, avoidance of hazards, revegetation, erosion and sediment control, and permanent retention/detention facilities. The responsibility for maintaining site stability and maintenance objectives for buffer vegetation and permanent erosion, sedimentation, and runoff control structures for the original permit requirements is the responsibility of the property owner once the work is complete and final restoration measures have been installed as per the plans or approved permit requirements.

Z. Ponds and Reservoirs

Grading and excavation to construct ponds and reservoirs shall:

1. Meet all applicable setbacks specified in this code, except for stormwater detention facilities authorized by the planning director or designee.
2. Maintain in-stream flows of natural drainage courses.
3. Protect adjacent property from damage.

AA. Site-Specific Requirements [NOTE: Add this to Construction section.](#)

Additional, site-specific requirements may be established after a site visit by the city. These requirements shall be based on specific site conditions and are limited to additional temporary erosion and sedimentation control and the mitigation of hazardous or potentially hazardous conditions that pose a threat off site or habitat preservation.

BB. Project Management

1. Construction site operators shall maintain, update and implement their SWPPP. Construction site operators shall modify their SWPPP whenever there is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.
2. For construction projects one acre or larger that discharge stormwater to surface waters of the state, a Certified Erosion and Sediment Control Specialist shall be identified in the Construction SWPPP and shall be on-site or on-call at all times. Certification may be obtained through an approved training program that meets the erosion and sediment control training standards established by Ecology.
3. - For sites disturbing less than one acre but are part of a common plan of development or sale that is one acre or larger, site inspections shall be conducted by a person who is knowledgeable in the principles and practices of erosion and sediment control. The inspector shall have the skills appropriate to:
 - (a) Assess the site conditions and construction site activities that could impact the quality of stormwater, and
 - (b) Assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.

A knowledgeable inspector shall also be required for the following construction sites that are less than one acre and have:

- (a) a minimum of 2,000 square feet of new, replaced, or new and replaced impervious surface; or
 - (b) a minimum of ~~72~~ 72,000 square feet of land disturbance.
4. Maintaining an Updated Construction SWPPP - The Construction SWPPP shall be retained on-site or within reasonable access to the site.
5. The SWPPP shall be modified whenever there is a significant change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.
6. The SWPPP shall be modified, if during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or

modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) calendar days following the inspection.

CC. Tree Retention

Trees shall be retained to the maximum extent feasible.

1. Clearing ~~should~~ shall not occur outside of the areas designated on the clearing plan.
2. No tree(s) or ground cover shall be removed from a native vegetation area or environmentally sensitive site unless that plot plan and other submitted materials can demonstrate that the removal will enhance the area. An exception for the installation of roads and utilities may be approved if it can be demonstrated that alternative access is not practical or would be more damaging and is developed pursuant to an approved development plan.
3. A tree replacement must be submitted to and approved by public works director, city engineer or designee.

Enhancement may include non-mechanical removal of noxious or intrusive species or dead or diseased plants and replanting of appropriate native species.

DD. Protection During Construction

Where the drip line of a tree overlaps a construction line, this shall be indicated on the survey and the following tree protection measures shall be employed:

1. The applicant may not fill, excavate, stack or store any equipment, or compact the earth in any way within the area defined by the drip line of any tree to be retained.
2. The applicant shall erect and maintain rope barriers on the drip line or place bales of hay to protect roots. In addition, the applicant shall provide supervision whenever equipment or trucks are moving near trees.
3. If the grade level adjoining a retaining tree is to be raised or lowered, the applicant shall construct a dry rock wall or rock well around the tree. The diameter of this wall or well must be equal to the tree's drip line.
4. The applicant may not install ground level impervious surface material within the area defined by the drip line of any tree to be retained.
5. The grade level around any tree to be retained may not be lowered within the greater of the following areas: (1) the area defined by the drip line of the tree, or (2) an area around the tree equal to one foot in diameter for each one-inch of tree caliper.
6. The applicant may prune branches and roots, fertilize and water as horticulturally appropriate for any trees and ground cover which are to be retained.

The public works director, city engineer or designee~~planning director or designee~~ may approve the use of alternative tree protection techniques if those techniques provide an equal or greater degree of protection than the techniques listed above.

18.23.065 Bonding.

The applicant shall post a performance bond equal to 125% in of the amount covering the installation of temporary erosion control measures and the clearing work to be done on the property and the cost of any proposed revegetation.

18.23.070 Violations and penalties.

A. A violation of any of the provisions of this chapter shall constitute a misdemeanor. It shall be a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this chapter is committed.

B. Any person found violating the provisions of this chapter may be fined by the public works director, city engineer or designee~~planning director~~ in an amount not to exceed \$1,000 per day and/or \$500.00 per tree. Any fine imposed by the public works director, city engineer or designee~~planning director~~ is appealable to the hearing examiner~~city council~~. This civil fine shall be in addition to any criminal, civil, or injunctive remedy available to the city.

C. The fines established in subsection (C) of this section shall be tripled to \$3,000 per day and/or \$1,500 per tree for clearing which occurs within any critical area or critical area buffer, in any earth subsidence or landslide hazard area, in any native vegetation area or in any area which is designated for transfer or dedication to public use upon final approval of a subdivision, planned residential development or other development permit.

18.23.075 Public and private redress.

A. Any person who violates any provision of this chapter or of a permit issued pursuant hereto shall be liable for all damages to public or private property arising from such violation, including the cost of restoring the affected area to its original condition prior to such violation and the payment of any levied fine.

1. Restoration shall include the replacement of all ground cover with a species similar to those which were removed or other approved species such that the biological and habitat values will be substantially replaced; and
2. For each tree removed, replacement planting of up to three trees of the same species in the immediate vicinity of the tree(s) which was removed so long as adequate growing space is provided for such species. The replacement trees shall be of sufficient caliper to adequately replace the lost tree(s). Replacement trees shall be a minimum of three inches in caliper and shall be replaced at the direction of the [public works director, city engineer or designee](#)~~planning director~~.

B. In order that replanted species shall have an opportunity to adequately root and establish themselves prior to disturbance by any future development, no permit shall be issued nor final approval given to any project until such time as all planting required to mitigate illegal activity has been fully implemented in accordance with an approved landscaping plan, and an adequate rooting period has expired. The plan shall meet the performance standards established in SMC 18.23.050. The phrase "adequate rooting period" is defined for the purposes of this section as a period of one calendar year from the date of planting; provided, however, that a developer or other impacted party may apply to the architectural design board for the establishment of a different rooting period. The architectural design board shall establish such period which may be longer or shorter than one calendar year based upon the species of the plants involved, the particular point in the growing cycle at which the application is reviewed, and the planting schedule. The architectural design board shall establish a rooting period based upon the best scientific and biological evidence available as necessary to reasonably insure the establishment of the plantings. In no event shall a rooting period be established as a penalty.

C. Restoration shall also include installation and maintenance of interim and emergency erosion control measures until such time as the restored ground cover and trees reach sufficient maturation to function in compliance via performance standards identified in SMC 18.23.050.

18.23.080 Additional remedies authorized.

Violation of SMC 18.23.035(A) or of any condition of approval regarding tree clearing, the protection of native growth or landscaping installation and maintenance shall, in addition to another remedy imposed by this code, be a violation of the provisions of this chapter and subject to the bonding, violation and penalty and public and private redress provisions of SMC 18.23.065, et seq.

Title 12
STREETS, SIDEWALKS AND PUBLIC PLACES

Chapters:

- 12.04 Sidewalk Use**
- 12.08 Sidewalk Construction**
- 12.10 Rights-of-Way**
- 12.12 Ditch Culverts**
- 12.16 Work Obstructing Public Places**
- 12.20 Naming of Streets**
- 12.22 Street Address Designation Policies**
- 12.24 Parks, Playgrounds and Public Places**
- 12.28 Mapped Streets**

Chapter 12.04
SIDEWALK USE

Sections:

- 12.04.010 Purpose.
- 12.04.020 Definitions.
- 12.04.030 Right to erect.
- 12.04.040 Duty to use proper care and caution.
- 12.04.050 Duty to repair and maintain.
- 12.04.060 Removal.
- 12.04.070 Insurance.
- 12.04.080 Approval of plans.
- 12.04.090 Annual inspection.
- 12.04.100 City's right to remove or repair.
- 12.04.110 Notice.
- 12.04.120 Penalties.

12.04.010 Purpose.

The purpose of the ordinance codified in this chapter is to allow owners of abutting property sidewalks in the city to erect and maintain western-type store fronts which call for pillar-supported coverings over sidewalks, and to allow the pillars to be attached to the sidewalks. (Ord. 304 § 1, 1974)

12.04.020 Definitions.

The following terms when used in this chapter shall be construed to mean as follows:

A. "Abutting property" means all property having a frontage on the sides or margins of any sidewalk.

B. "Owner" means the plural as well as the singular and includes any partnership, association, group or corporation other than a public body.

C. "Sidewalk" means a walk for pedestrian use outside the building lot line of any property owner and constructed for use by the general public.

D. "Structure" means any covering, roof or other extension of a building which projects over and covers the sidewalk. (Ord. 304 § 2, 1974)

12.04.030 Right to erect.

Every owner of property abutting the sidewalks of the city in the areas of the city zoned BL shall have the right to erect and maintain structures over the abutting sidewalks. Such structures may have pillars attached to the sidewalks. The structures shall be self-supporting and shall not be dependent upon any attached pillars. Fire stops shall be incorporated therein as required by the city building inspector. (Ord. 304 § 3, 1974)

12.04.040 Duty to use proper care and caution.

Every owner who erects a structure as defined in this chapter shall use proper care and caution in the construction and maintenance of it all in accordance with the state and city ordinances relating to buildings. (Ord. 304 § 4, 1974)

12.04.050 Duty to repair and maintain.

Structures shall be repaired and maintained at the owner's expense. (Ord. 304 § 5, 1974)

12.04.060 Removal.

Every owner of property abutting the sidewalks of the city which has such a

structure attached shall have the option to completely and permanently remove the structure at the owner's expense. (Ord. 304 § 6, 1974)

12.04.070 Insurance.

A. Every owner of property abutting the sidewalks of the city which has such a structure attached shall at all times, commencing with the date upon which construction begins, carry the following types of insurance with an insurance carrier or carriers acceptable to the city, and policies approved by the city.

B. Public liability insurance covering death or bodily injuries with limits of not less than \$100,000 per person and \$250,000 for any one accident or disaster, and property damage coverage with limits of not less than \$50,000, which insurance shall name the city as an additional insured. (Ord. 304 § 7, 1974)

12.04.080 Approval of plans.

Before construction of such structure commences or before alterations of it are made, plans for construction or alterations must first be submitted to and be approved by the city building inspector. (Ord. 304 § 8, 1974)

12.04.090 Annual inspection.

The structures are subject to annual inspection by the city building inspector. Should it be determined that a structure is or has become a public nuisance or in any manner endangers the public use of the sidewalks, then the owner of the property abutting the sidewalks to which such structure is attached shall correct the situation

upon 60 days' notice, such notice to be given as provided in SMC 12.04.110, by repair, reconstruction, removal or such other

action as shall be determined by the city building inspector. (Ord. 304 § 9, 1974)

12.04.100 City's right to remove or repair.

The city shall, upon 30 days' notice, such notice to be given as provided in SMC 12.04.110, have the right to repair, reconstruct or remove such structure if any abutting property owner fails to comply with any of the provisions of this chapter. The cost to the city of such repairs, reconstruction or removal, including the engineer's expenses, shall be charged to the abutting property owner. If the property owner fails or refuses to pay the costs incurred by the city or in the event the owner cannot be found, the city may file a lien therefore against the property within 90 days. (Ord. 304 § 10, 1974)

12.04.110 Notice.

Any notice required by this chapter shall be given by mailing a copy of the notice to the owner as shown upon the records of the county treasurer and at the address shown thereon; and if no owner and address is shown on such record, a copy of the notice shall be posted upon the property, and shall also be published in one issue of the Sequim newspaper. Proof of such mailing, posting and publication shall be made by affidavit filed with the city clerk. The notice shall include a description of the property involved and in connection with SMC 12.04.090 it shall include the nature of the hazardous condition and the action required by the city building inspector and in connection with SMC 12.04.100 it shall include a description of the violations of this chapter. (Ord. 304 § 11, 1974)

12.04.120 Penalties.

Any person violating any of the provisions

of this chapter, in addition to the costs required in SMC 12.04.100, shall, upon conviction, be punished by a fine in a sum not to exceed \$300.00 or by imprisonment in the city jail for a period not to exceed 90 days or by both such fine and imprisonment. (Ord. 304 § 12, 1974)

Chapter 12.08

SIDEWALK CONSTRUCTION

Sections:

12.08.010 Purpose.

12.08.020 Definitions.

12.08.030 Plans and specifications – Permits – Performance bond.

12.08.040 Sidewalks to be constructed in platted areas prior to acceptance.

12.08.050 Driveway entrances required.

12.08.060 Minimum standards.

12.08.070 Vertical and wedge curbs and gutters.

12.08.080 Driveway standards.

12.08.090 Base preparation.

12.08.093 Sidewalk Surfacing

12.08.095 Low Impact Development (LID)

12.08.100 Violation – Penalty.

12.08.010 Purpose.

The uncontrolled construction, maintenance and repair of sidewalks, driveways, curbs and gutters has created such hazards to the health, safety and welfare of the people of the city that it is necessary for the city, in exercise of its police power, to establish regulations governing the same. Final inspections of any work described in this title are required and the city shall have a 24-hour notice from the applicant of completed work with a requested inspection. Work completed without a final inspection shall invalidate a permit. (Ord. 2005-019; Ord. 279 § 1, 1973)

12.08.020 Definitions.

As used in this chapter, the words defined in

this section shall have the following meanings:

A. “Person” means the plural as well as the singular and includes any partnership, association, group or corporation.

B. “Sidewalk” includes any and all structures or forms of street improvement included in the space between the street margin and the roadway but shall not include trails, paths or pathways.

C. “Trail, path or pathway” includes recreational walkways, which may be a component of parks or open spaces. (Ord. 2005-019; Ord. 279 § 2, 1973)

12.08.030 Plans and specifications – Permits – Performance bond.

No sidewalk, driveway, curb or gutter within the city shall hereafter be constructed, altered or repaired by any person without a written permit first being obtained from the offices of the city clerk and public works. Two sets of pPlans and specifications for the construction, alteration or repair of sidewalks, driveways, curbs and gutters shall first be submitted to the city for approval.

Such plans and specifications shall contain the layout with dimensions, existing ground elevation and proposed finished grade elevation for the work intended. When requested by the city the request for permit must be accompanied by a performance bond or certified check, payable to the city, in an amount that is not less than the estimated construction cost. (Ord. 2005-019; Ord. 279 § 4, 1973)

12.08.040 Sidewalks to be constructed in platted areas prior to acceptance.

Sidewalks, curbs and gutters shall be constructed in all areas to be platted or replatted prior to the acceptance by the city of the platted or replatted areas. All public sidewalks, curbs and gutters shall be

constructed of concrete or surface material described in 12.08.093 where feasible. (Ord. 2005-019; Ord. 279 § 5, 1973)

12.08.050 Driveway Standards

A. All driveways on public property shall be cement concrete driveways or surface material described in 12.08.093 where feasible as specified and approved by the city engineer as set forth in SMC 12.08.050. The width of driveways shall be a minimum of nine feet and a maximum of 30 feet. Existing curbs and sidewalks over which a driveway is to be placed shall be neatly cut and removed. Driveways on private property shall be constructed of concrete or asphalt or surface material described in 12.08.093 where feasible. (Ord. 2005-019; Ord. 279 § 9, 1973)

B. Where it becomes necessary for access across any sidewalk, whether existing or proposed, with any vehicle, a driveway shall be constructed. Driveway aprons, where they cross public sidewalks constructed of concrete, shall be constructed of concrete or surface material described in 12.08.093 where feasible. Where no public sidewalks have been constructed, driveway aprons may be constructed of asphalt or surface material described in 12.08.093 where feasible. (Ord. 2005-019; Ord. 279 § 6, 1973)

12.08.060 Minimum standards.

All sidewalks in the areas designated by the city as “commercial” or “mixed use” shall be a minimum of eight feet wide from back of curb or landscape strip. All sidewalks in residential areas shall be a minimum of six feet wide from back of curb or landscape strip. All sidewalks shall be constructed with a minimum ~~four~~three-inch thickness. Driveway entrance sidewalks shall be a minimum six-inch thickness and as identified in the City of Sequim Streets and

Utilities Development Regulations Detail SQMR8.

(Ord. 2006-019 § 1; Ord. 2005-019; Ord. 279 § 7, 1973)

12.08.070 Vertical and wedge curbs and gutters.

All vertical and wedge curbs and gutters shall be combined concrete curb and gutters as specified and approved by the city engineer. Appropriate application for vertical and wedge curbs shall be in conformance with the street profiles identified as Detail SQM-R1A, R1B, R2A, R2B and R2C in the City of Sequim Streets and Utilities Development Regulations. Design standards are identified in Detail SQM-R5 and SQM-R6. (Ord. 2006-019 § 1; Ord. 2005-019; Ord. 279 § 8, 1973)

~~12.08.080 Driveway standards.~~

~~All driveways on public property shall be cement concrete driveways as specified and approved by the city engineer as set forth in SMC 12.08.050. The width of driveways shall be a minimum of nine feet and a maximum of 30 feet. Existing curbs and sidewalks over which a driveway is to be placed shall be neatly cut and removed. Driveways on private property shall be constructed of concrete or asphalt. (Ord. 2005-019; Ord. 279 § 9, 1973)~~

12.08.090 Base preparation.

All structural materials hereinafter used in repairing or construction of sidewalks shall be placed upon a carefully prepared base meeting American Public Works Association (APWA) standards or Washington State Department of Transportation standards (WSDOT). Concrete shall be American Public Works

Association Class 5 (1-1/2) or 5 (3/4). (Ord. 2005-019; Ord. 279 § 10, 1973)

12.08.093 Driveway and Sidewalk Surfacing.

Driveways and sidewalks shall be surfaced with a material appropriate for the soil type, and use. Permeable surfacing materials shall be used whenever site and soil conditions make it a feasible option, as determined by the City Engineer. Permeable surfacing includes, but is not limited to: paving blocks, pervious concrete, porous asphalt, and other similar approved materials. Pervious materials shall be constructed in accordance with the *LID Technical Guidance Manual for Puget Sound* (current version) and the manufacturer's recommendations.

12.08.095 Low Impact Development (LID).

The City may approve alternatives to the minimum sidewalk standards set forth in this chapter in order to accommodate proposed LID best management practices (BMPs). LID BMPs shall be used where site and soil conditions make LID feasible, as determined by the City Engineer. LID BMPs shall be designed and constructed in accordance with the City of Sequim's LID Design Standards 18.22.035 -and the *LID Technical Guidance Manual for Puget Sound* (current edition).

12.08.100 Violation – Penalty.

Any person violating any of the provisions of this chapter shall, upon conviction, be punished by a fine in a sum that is not more than ~~\$300~~\$1,000.00. (Ord. 2005-019; Ord. 279 § 11, 1973)

Chapter 12.10 RIGHTS-OF-WAY

Sections:

12.10.010 Findings and purpose.

12.10.020 City property.

12.10.022 Right-of-way surfacing

12.10.025 Low Impact Development (LID)

12.10.010 Findings and purpose.

The city council finds that it is in the public interest to establish standards for use of the rights-of-way and/or easements for service providers and other owners and operators of utility systems, in a manner which:

- A. Provides terms, conditions and cost under which service providers and other operators of utility systems may use valuable public property to serve the public.
 - B. Protects the public interest in the use of the limited physical capacity of the public rights-of-way and/or easements.
 - C. Protects the public and the city from any harm resulting from such private use of rights of-way and/or easements and preserves and improves the aesthetics of the community.
 - D. Protects and carries out the regulatory authority of the city and recovers costs.
- (Ord. 2006-002 § 1)

12.10.020 City property.

The city council finds that the city's rights of-way, other city property, and utility facilities such as water conduits, sewer conduits, poles and other conduits within the city constitute valuable public property:

- A. That can be partially occupied by private companies and other entities for facilities used in the delivery, conveyance, and transmission of telecommunications, utility and public services rendered for profit, to the enhancement of the health, welfare, and general economic well being of the city and its citizens.
- B. That ~~are at the city's right-of-ways are a~~ unique resource ~~so~~ that requires proper management by the city's staff, and is necessary to maximize the efficiency and minimize the costs to the taxpayers of the

foregoing uses and to minimize the inconvenience and negative effects, including degradation, upon the public from such facilities' construction, emplacement, relocation, and maintenance in the rights-of way.

C. Encourage proper development while preserving aesthetic and other community values and preventing proliferation of above ground facilities and damaged rights-of-way and/or easements.

D. Recover the city's current and ongoing costs of granting and regulating access to and use of the public rights-of-way and/or easements from the persons and businesses seeking such access and causing such costs.

E. Fees, insurance, warranties, repair and construction and excavation requirements shall include the following:

1. Repair of Damages. A franchisee, its successors and assigns shall promptly repair any damage of every type and nature to city property or city improvements caused by the failure or workmanship of the franchisee's work during the life of a franchise. Patches in the public right-of-way must be restored or maintained by franchisee to the satisfaction of the city engineer until the area is repaved.

2. Public Ways and Property – Telecommunications, Cable – Municipal Authorization to Use Right-of-Way – Conditions of Occupancy or Use of the Right-of-Way. The following requirements apply as minimum conditions of installing, locating, using, maintaining, abandoning or removing facilities in the right-of-way or other permitted areas, whether by a service provider or any other user. They are a basis of negotiation of any franchise or master permit. Service providers or other users must accept the requirements, so long as any

use or occupancy continues, regardless of whether a master or use permit or franchise has been issued, revoked or expired:

a. Users must comply with all applicable federal and state laws relating to operations in the city of Sequim, including safety laws and standards, as well as local ordinances, this chapter, and the policies and standards of the city, construction codes, regulations, and orders of the public works department, compliance all being further subject to audit or verification by the city at the users' expense.

b. Users must obtain all [approved](#) permits required by the city for the installation, maintenance, repair, or removal of facilities in the right-of-way and pay all permit and filing fees, costs, charges and penalties within 30 days of billing or as otherwise specified by the public works department.

c. Users must always act in good faith and fair dealings with the public and must provide safe, reliable service to the public. Users must cooperate with the city to ensure their facilities are installed, maintained, repaired, and removed within the right-of-way or other permitted areas in compliance with the purposes of this chapter and in such a manner and at such points so as not to inconvenience the public use or to adversely affect the public health, safety, and welfare.

d. Users must provide information and plans the city requires to enable the city to comply with and enforce this chapter, including provision of advance planning information pursuant to the procedures established by the public works department. Users must keep the public works department fully informed of any changes to information required to be supplied with any master permit or franchise or any use permit.

e. Users must provide advance notice of long and short range needs for access to the right-of-way or other permitted areas as may be ordered by the public works

department, and otherwise, as much as reasonable in order to facilitate the scheduling and coordination of work in the right-of-way or other permitted areas.

f. Users must obtain the written approval of the facility or structure owner, if they do not own it, prior to attaching to or otherwise using a facility or structure in the right-of-way or other permitted areas, and construct, install, operate, and maintain their facilities at their sole expense and liability except as otherwise provided by law or agreement. (Crossreference: RCW 35.99.030(6).)

g. The city must not be exposed to any loss, liability or expense because of another's use or occupancy of the right-of-way or other permitted areas. Users must fully indemnify and hold harmless the city, its officers, agents and employees, from all loss or liability in connection with their use or occupancy of such areas. Operations in or near the right-of-way or other permitted areas should be conducted to minimize or avoid hazard to the public or interfere with the priority of municipal infrastructure needs. Users must further pay for loss or damage to municipal assets or injury to municipal personnel. If the city nonetheless is exposed to risk or loss, users must protect and defend the city to the maximum extent permitted by law. Minimum insurance requirements pending any use or occupancy of the right-of-way or other permitted area are \$500,000 per occurrence and \$1,000,000 aggregate, with the city of Sequim as an additional named insured or as otherwise ordered by the administering officer with the advice of the risk manager.

h. The city is not responsible for construction or maintenance of any facilities placed and has no duty to modify the right-of way or other permitted areas to accommodate such facilities. All areas utilized must be accepted "as is," without express or implied assurances of suitability

of any area for facilities placed. Users must assume all risk of facility placement and occupancy, including risks now or hereafter arising because of lack of municipal resources to maintain the municipal infrastructure or any component in current or better condition. Users must waive any claim against the city for loss or liability arising from acts or omissions of other users, occupants or the public, because of unstable earth or roadbed, changes in groundwater conditions or other natural or artificial conditions rendering the right-of-way or other permitted areas unsuitable for use for facilities placed or any other problem. This does not affect the applicability of Chapter 19.122 RCW, Washington State's underground utilities statute.

i. There is no warranty of any municipal title or interest to confer permission to use or access any area. Permission is in the nature of a quitclaim authorization, subject to any other underlying interests as may be established. The city further reserves the right to vacate or abandon any permitted area at no cost or liability to the city. Municipal infrastructure needs have first priority in all cases except and only so far as shown to be otherwise required by a preemptive right.

j. There is no duty or liability of the city to any third-party tenant in or on a user's facilities in the right-of-way or other permitted areas, or to any direct or indirect customers or third-party beneficiaries of a user. The city disclaims any such duty or responsibility. Users must accept sole responsibility for claims of their direct or indirect third-party tenants, customers or third-party beneficiaries.

k. Nothing in this chapter limits or restricts any requirement, duty or obligation heretofore arising to the benefit of the city as a result of any municipal contract, permit, or

franchise, but such provisions are supplemental and in addition to this chapter. The provisions of this chapter are supplemental and in addition to other applicable municipal ordinances, standards, and requirements. Nothing in this chapter impairs any obligation of contract in violation of the Constitution of the State of Washington or the United States.

(Cross-reference: RCW 35.99.080(c).)

l. Any damage or disturbance to the right-of-way or other permitted or surrounding areas must be promptly restored. A patch must be thereafter maintained by the responsible party as determined by the administering officer until the area is repaved. The public works department may require the responsible party to repave an entire lane within a cut or disturbed location, or greater area, if deemed affected. Common trenching and coordination of access needs by the user is required to avoid unnecessary cuts or damage to the right-of way or other permitted areas. In addition, all patching and or paving shall be warranted against defects or failure for a period of two years from the date of completion of the work.

m. Access may be limited by the administering officer at a location, considering the purpose of this chapter, where there is inadequate space or other special limitations in an area. Minimum underground horizontal separation is five feet from city water facilities and 10 feet from above-ground city water facilities, subject to the public works department's review and further determination.

n. Any assignment of use or occupancy privileges requires consent of the city in the manner originally granted. This does not apply to minor stock transfers. No capital stock may ever be issued based on any permission to use or occupy the right-of-way or other permitted areas or the value thereof. In any condemnation proceeding brought by

the city, no grantee of any permission, permit or franchise under this chapter or otherwise shall ever be entitled to receive any return thereon, or its value.

o. Fees for all such services shall be set by resolution by the city council. (Ord. 2006-002 § 2)

12.10.022 Right-of-Way Surfacing.

Right-of-way surfacing shall be a material appropriate for the soil type, use, and associated vehicular traffic. Permeable surfacing materials are encouraged whenever site and soil conditions make it a feasible option, as determined by the City Engineer. Permeable surfacing includes, but is not limited to: paving blocks, pervious concrete, porous asphalt, and other similar approved materials. Permeable surfacing materials may be approved for parking areas, emergency parking areas, public and private roads, road shoulders, bike paths, walkways, driveways, and easement service roads, unless site constraints make the use of such materials detrimental to water quality, public health, or safety. Pervious materials shall be constructed in accordance with the *LID Technical Guidance Manual for Puget Sound* (current version) and the manufacturer's recommendations.

12.10.025 Low Impact Development.

The City may approve alternatives to the right-of-way standards set forth in this chapter in order to accommodate proposed LID design techniques. LID best management practices (BMPs), (such as bioretention swales), shall be used where site and soil conditions make LID feasible. LID BMPs shall be designed and constructed in accordance with the City of Sequim's LID Design Standards 18.22.035) and the *LID Technical Guidance Manual for Puget Sound* (current edition).

Chapter 12.12

DITCH CULVERTS

Sections:

12.12.010 Ditch culverts subject to regulations.

12.12.020 Application to construct – Standards.

12.12.030 Costs.

12.12.040 Street commissioner duties.

12.12.010 Ditch culverts subject to regulations.

All irrigation ditches crossing the public streets or alleys of the city, and known as ditch culverts, must conform to the regulations prescribed in this chapter, except that irrigation ditches now in use and which are now running across streets or alleys are exempted from the regulations of this chapter until such time as such crossing ditches are required to be altered or repaired to prevent flooding the street or damage to property. (Ord. 32 § 1, 1915)

12.12.020 Application to construct – Standards.

A. Irrigation ditch companies, or their officers or stockholders desiring to have an irrigation ditch run across a public street or alley must make application to the city's Public Works Director or City Engineer ~~street commissioner~~ to construct a ditch culvert, and such culvert must be constructed under the supervision of the ~~commissioner~~ City Engineer. The ditch culvert must be of a size to be agreed upon between the applicant constructing it and the ~~commissioner~~ City Engineer, subject to this chapter.

B. Ditches must be constructed of either corrugated iron or concrete, ~~or three-inch plank~~, and the construction work is to be done in such a way as to leave no ridge or hummock or other obstruction in the street or alley so as to interfere with vehicle or other street traffic. Whenever it is necessary

to prevent street flooding or damage to property, siphons must be provided with such culverts. (Ord. 32 § 2, 1915)

Sequim Municipal Code 12.16.030

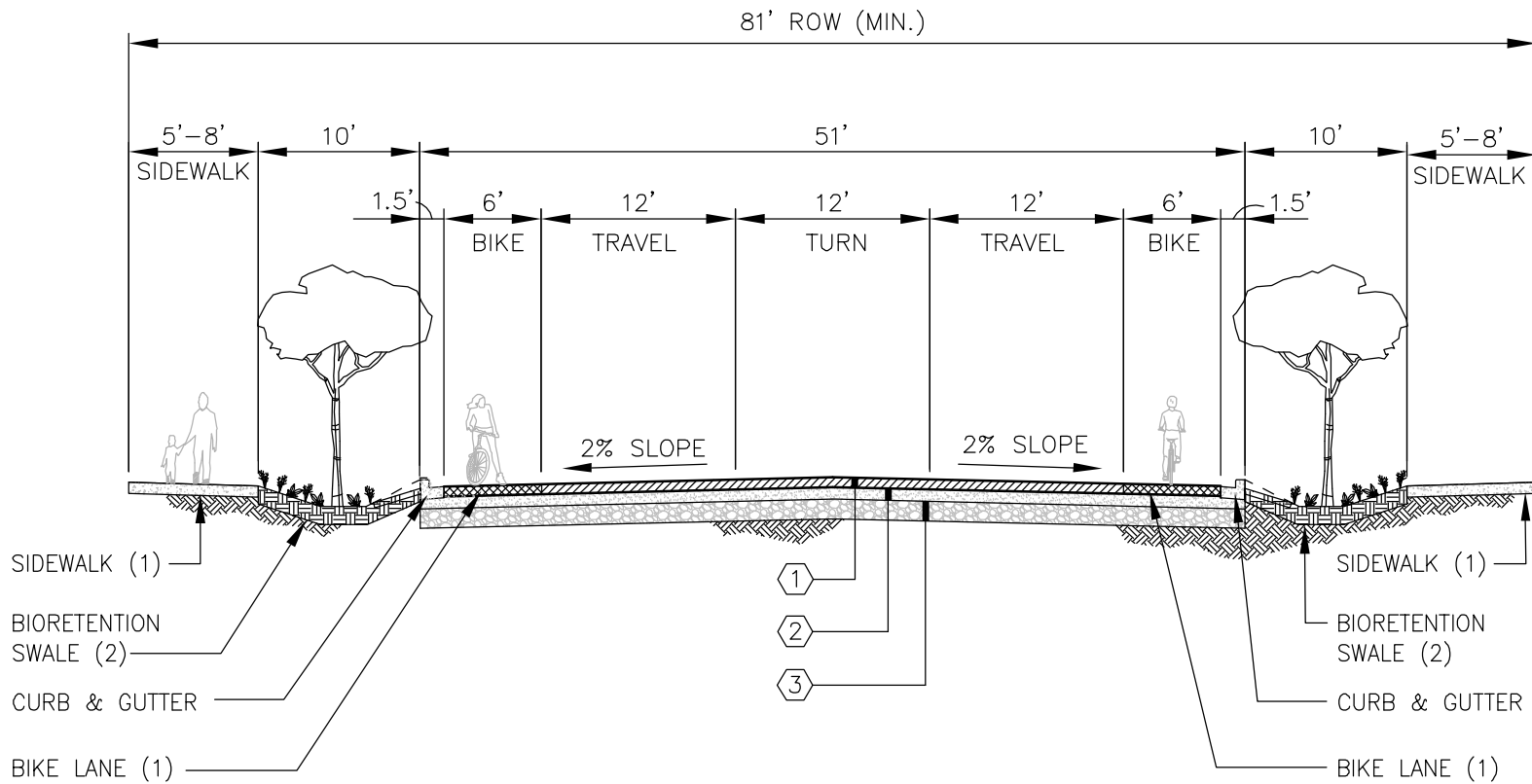
12.12.030 Costs.

A. All of the cost of construction of irrigation ditch culverts must be borne and paid for by the applicant or by the irrigation ditch company or other person desiring the work done.

B. Street crossings above such ditch culverts will be ~~constructed and~~ maintained at the expense of the city, but all ditch culverts must be maintained and kept in good repair at the expense of the irrigation ditch companies or owners of the ditch culvert. (Ord. 32 § 3, 1915)

12.12.040 Street commissioner duties.

~~It is the duty of the street commissioner whenever any irrigation ditch crossing or culvert is defective and needs repairs and alterations so as to prevent flooding of the streets or any damage to property, to notify the president, or secretary or trustee, or any officer of the irrigation ditch company with whose main ditch the ditch culvert connects in any way, to proceed to make the needed repairs to the defective culvert or crossing within three days from the receipt of such notice. In case the ditch company fails or refuses to make the needed repairs as~~

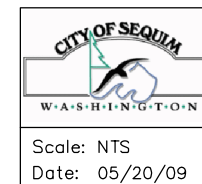


NOTES

- BIKE LANE AND SIDEWALKS MAY BE PERVIOUS WHERE SITE AND SOIL CONDITIONS MAKE FEASIBLE, AS DETERMINED BY PUBLIC WORKS. SEE LID-08 FOR PERVIOUS PAVING DETAILS.
- BIORETENTION SWALES SHALL BE USED ONLY WHERE SITE AND SOIL CONDITIONS MAKE FEASIBLE, AS DETERMINED BY PUBLIC WORKS. SEE LID-06 FOR PLANTING SWALE.

	MINOR ARTERIAL	COLLECTOR	LOCAL ACCESS
(1) ASPHALT CLASS B	4.0"	3.0"	3.0"
(2) CRUSHED SURFACING TOP COURSE	4.0"	3.0"	3.0"
(3) GRAVEL BASE (1)	10.0"	10.0"	8.0"

(1) BASE MAY NEED TO BE INCREASED DEPENDING ON SUITABILITY OF NATIVE MATERIAL.



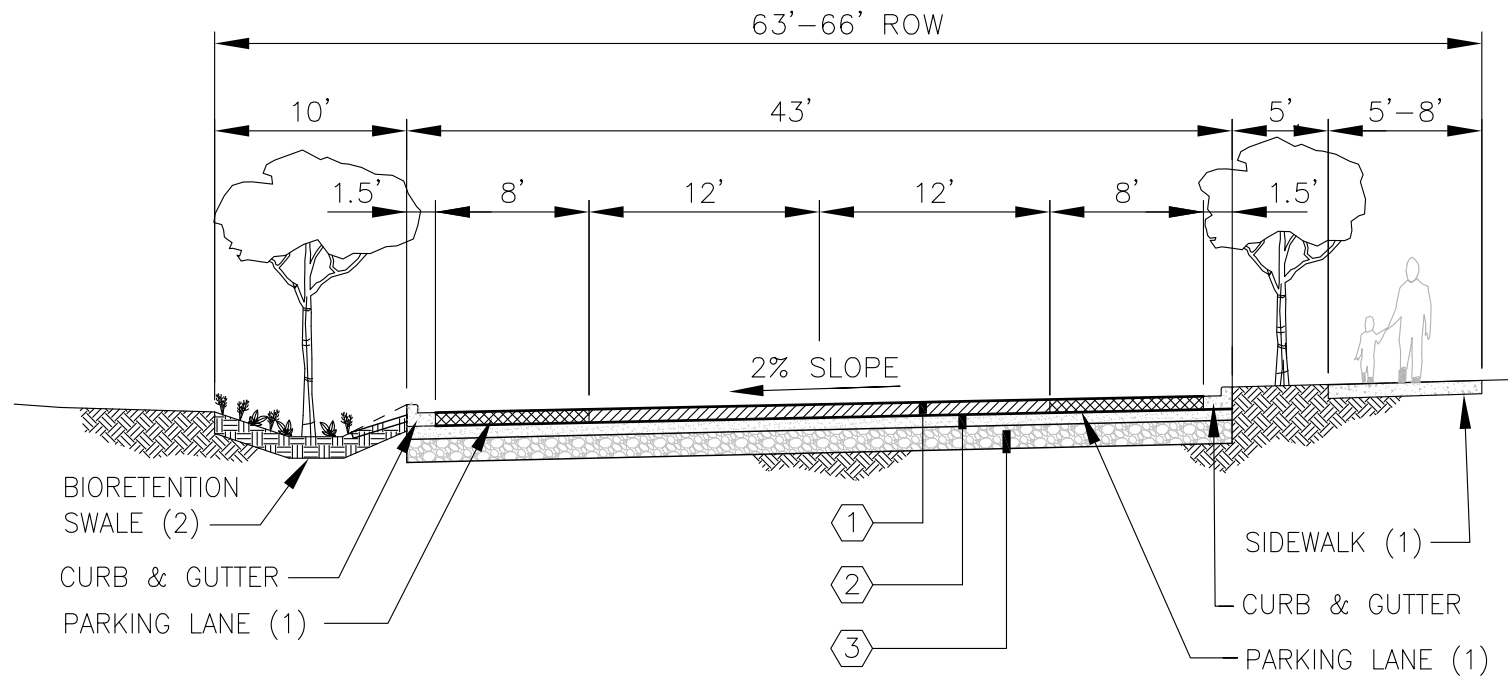
LID ROAD SECTION ARTERIAL STREET

LID-01

APPROVED BY

CITY OF SEQUIM ENGINEER

DATE



NOTES

1. PARKING LANES AND SIDEWALKS MAY BE PERVIOUS WHERE SITE AND SOIL CONDITIONS MAKE FEASIBLE. SEE LID-08 FOR PERVIOUS PAVING DETAILS.
2. BIORETENTION SWALES SHALL BE USED ONLY WHERE SITE AND SOIL CONDITIONS MAKE FEASIBLE, AS DETERMINED BY PUBLIC WORKS. SEE LID-06 FOR PLANTING SWALE.

	MINOR ARTERIAL	COLLECTOR	LOCAL ACCESS
1 ASPHALT CLASS B	4.0"	3.0"	3.0"
2 CRUSHED SURFACING TOP COURSE	4.0"	3.0"	3.0"
3 GRAVEL BASE (1)	10.0"	10.0"	8.0"

(1) BASE MAY NEED TO BE INCREASED DEPENDING ON SUITABILITY OF NATIVE MATERIAL.



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Date: 05/20/09

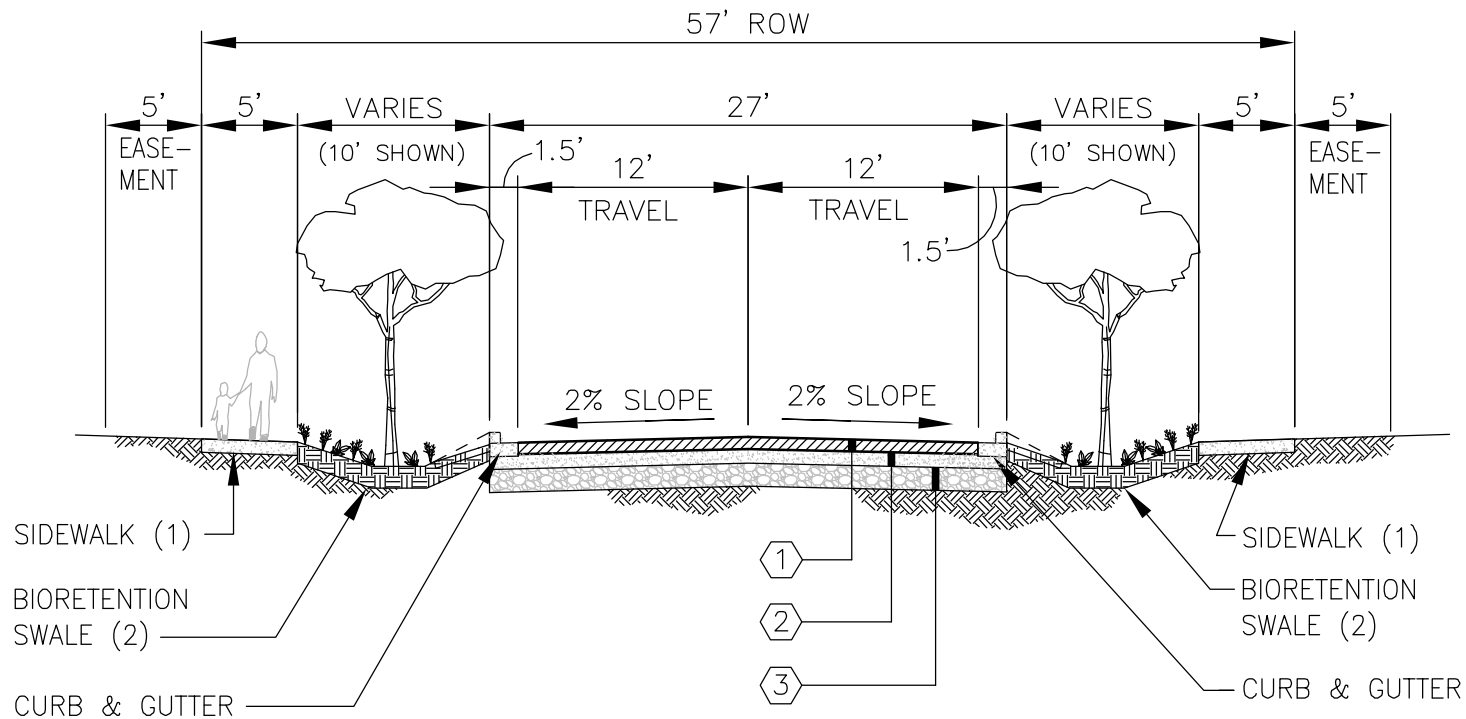
LID MINOR COLLECTOR 63'-66' RIGHT-OF-WAY

LID-02

APPROVED BY

CITY OF SEQUIM ENGINEER

DATE

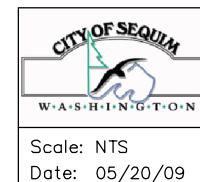


NOTES

1. SIDEWALKS MAY BE PERVIOUS WHERE SITE AND SOIL CONDITIONS MAKE FEASIBLE. SEE LID-08 FOR PERVIOUS PAVING DETAILS.
2. BIORETENTION SWALES SHALL BE USED ONLY WHERE SITE AND SOIL CONDITIONS MAKE FEASIBLE, AS DETERMINED BY PUBLIC WORKS. SEE LID-06 FOR PLANTING SWALE.

	MINOR ARTERIAL	COLLECTOR	LOCAL ACCESS
1 ASPHALT CLASS B	4.0"	3.0"	3.0"
2 CRUSHED SURFACING TOP COURSE	4.0"	3.0"	3.0"
3 GRAVEL BASE (1)	10.0"	10.0"	8.0"

(1) BASE MAY NEED TO BE INCREASED DEPENDING ON SUITABILITY OF NATIVE MATERIAL.



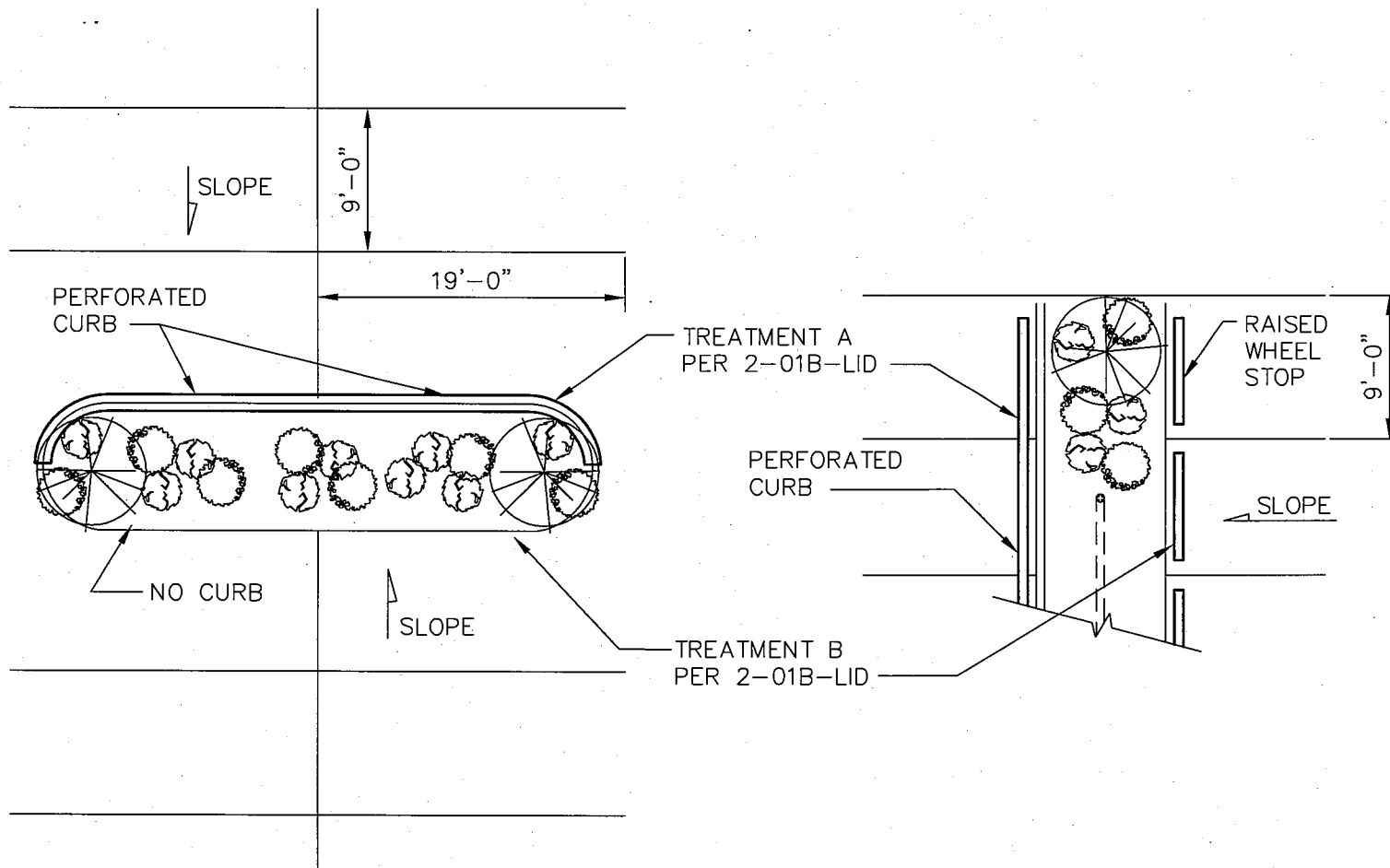
LID ROAD SECTION NEIGHBORHOOD STREET

LID-03

APPROVED BY

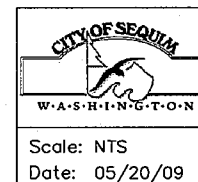
CITY OF SEQUIM ENGINEER

DATE



NOTES:

1. UNDERDRAINS ARE ONLY PERMITTED IN SOILS WITH INFILTRATION RATES INADEQUATE TO MEET MAXIMUM POOL AND SYSTEM DEWATER RATES.
2. WHERE PERFORATED CURBS, OR WHEEL STOPS FLUSH WITH THE PAVEMENT ARE USED, APPROXIMATELY 6 INCHES OF ROCK OR OTHER EROSION PROTECTION MATERIAL SHOULD BE USED TO DISSIPATE ENERGY AND/OR FLOW DISPERSION. SEE DETAILS 2-01B-LID.
3. BIORETENTION SWALES SHALL BE USED ONLY WHERE SITE AND SOIL CONDITIONS MAKE FEASIBLE, AS DETERMINED BY PUBLIC WORKS.



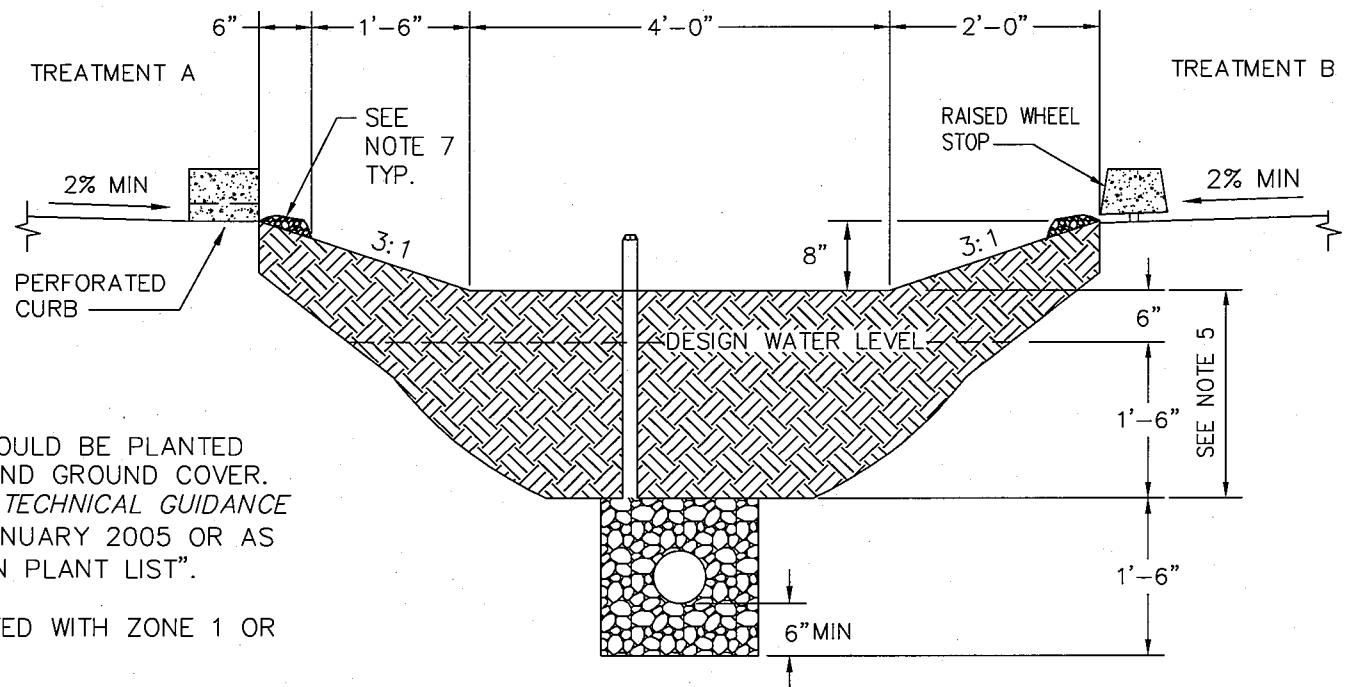
**LID PARKING ISLAND
PLAN: TREATMENT A & B**

LID-04

APPROVED BY


CITY OF SEQUIM ENGINEER

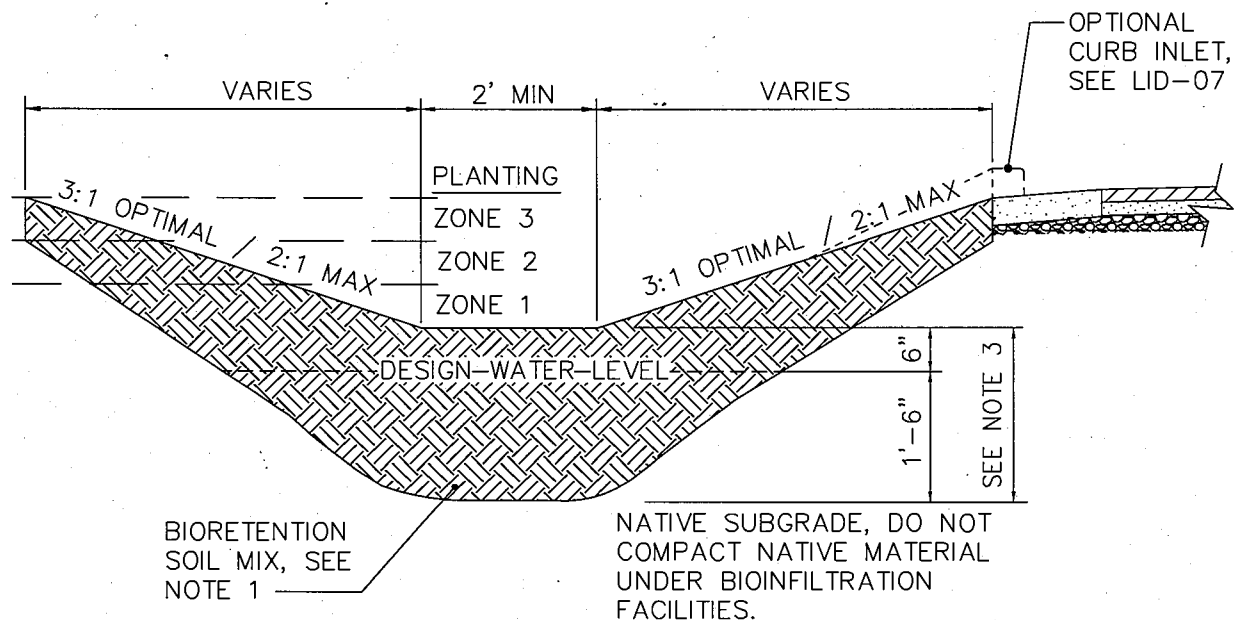
DATE



NOTES:

1. FLOOR OF PLANTING ISLAND SHOULD BE PLANTED WITH ZONE 1 TREES, SHRUBS AND GROUND COVER. SEE APPENDIX 3 – IN THE *LID TECHNICAL GUIDANCE MANUAL FOR PUGET SOUND* (JANUARY 2005 OR AS AMENDED) FOR A "BIORETENTION PLANT LIST".
2. SIDE SLOPES SHOULD BE PLANTED WITH ZONE 1 OR 2 GROUND COVERS.
3. BIORETENTION SOIL, COMPOSITION AND pH LEVELS SHALL MEET THE STANDARDS SET FORTH IN CHAPTER 6 OF THE *LID TECHNICAL GUIDANCE MANUAL FOR PUGET SOUND* (JANUARY 2005 OR AS AMENDED).
4. PLANTING SHALL CONSIST OF NATIVE SPECIES ABLE TO TOLERATE VARIABLE SOIL MOISTURE CONDITIONS, PONDING WATER FLUCTUATIONS, AND VARIABLE SOIL MOISTURE CONTENT.
5. AT LEAST 18 INCHES OF BIORETENTION SOIL MIX IS REQUIRED BELOW THE DESIGN WATER ELEVATION. ABOVE THIS ELEVATION AT LEAST 6 INCHES OF BIORETENTION SOIL MIX IS REQUIRED. COMPACT SUBSOILS MUST BE SCARIFIED AT 4 INCHES BELOW THE AMENDED LAYER.
6. UNDERDRAINS ARE ONLY PERMITTED IN SOILS WITH INFILTRATION RATES INADEQUATE TO MEET MAXIMUM POOL AND SYSTEM DEWATER RATES.
7. WHERE PERFORATED CURBS, OR WHEEL STOPS FLUSH WITH THE PAVEMENT ARE USED, APPROXIMATELY 6 INCHES OF ROCK OR OTHER EROSION PROTECTION MATERIAL SHOULD BE USED TO DISSIPATE ENERGY AND/OR FLOW DISPERSION.

 <p>CITY OF SEQUIM WASHINGTON</p>	<p>LID PARKING ISLAND PLANTING SWALE</p>	
<p>Scale: NTS Date: 05/20/09</p>	<p>LID-05</p>	
<p>APPROVED BY _____</p> <p>CITY OF SEQUIM ENGINEER _____ DATE _____</p>		



NOTES:

1. THE WIDTH OF BIORETENTION SWALES WILL VARY DEPENDING ON THE AMOUNT OF RUNOFF IT IS DESIGNED TO HOLD. BIORETENTION SWALES SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH THE *LID TECHNICAL GUIDANCE MANUAL FOR PUGET SOUND* (CURRENT EDITION).
2. BIORETENTION SOIL, COMPOSITION AND pH LEVELS SHALL MEET THE STANDARDS SET FORTH IN THE *LID TECHNICAL GUIDANCE MANUAL FOR PUGET SOUND* (CURRENT EDITION).
3. PLANTING SHALL CONSIST OF NATIVE SPECIES ABLE TO TOLERATE VARIABLE SOIL MOISTURE CONDITIONS, PONDING WATER FLUCTUATIONS, AND VARIABLE SOIL MOISTURE CONTENT. SEE APPENDIX 3 – IN THE *LID TECHNICAL GUIDANCE MANUAL FOR PUGET SOUND* (JANUARY 2005 OR AS AMENDED) FOR A "BIORETENTION PLANT LIST" BY ZONE.
4. AT LEAST 18 INCHES OF BIORETENTION SOIL MIX IS REQUIRED BELOW THE DESIGN WATER ELEVATION. ABOVE THIS ELEVATION AT LEAST 6 INCHES OF BIORETENTION SOIL MIX IS REQUIRED. COMPACT SUBSOILS MUST BE SCARIFIED AT 4 INCHES BELOW THE AMENDED LAYER.
5. UNDERDRAINS ARE REQUIRED IN SOILS WITH INFILTRATION RATES INADEQUATE TO MEET MAXIMUM POOL AND SYSTEM DEWATER RATES.
6. SEE LID-07 FOR CURB INLETS.
7. ZONE 1 PLANTINGS SHOULD BE USED BELOW THE DESIGN WATER ELEVATION.



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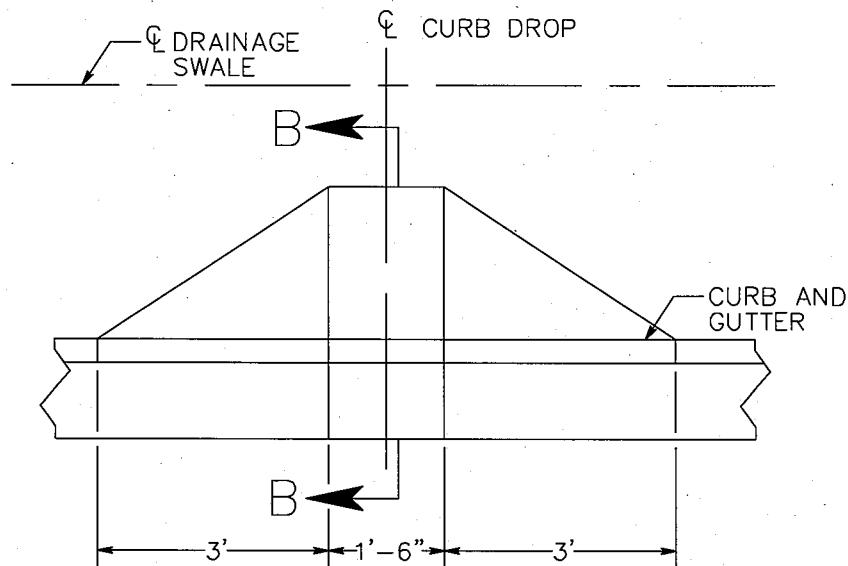
**LID STANDARD DETAIL
BIORETENTION SWALE**

LID-06

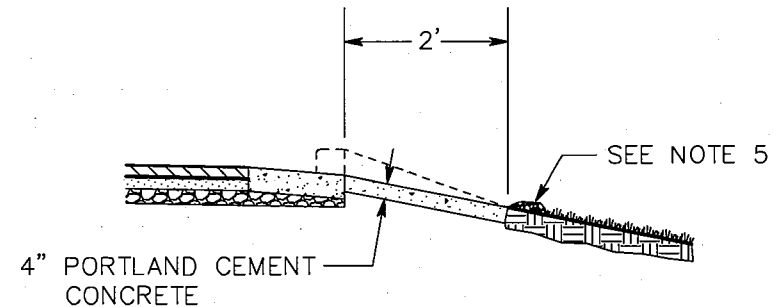
APPROVED BY

CITY OF SEQUIM ENGINEER

DATE



CURB INLET PLAN - TYPE 1



CURB INLET SECTION B-B

GENERAL NOTES

1. CURB INLET SHALL BE CONSTRUCTED IN ACCORDANCE WITH ASTM C 478 (AASHTO M 199) & ASTM C 890 UNLESS OTHERWISE SHOWN ON PLANS OR NOTED IN THE PROJECT SPECIAL PROVISIONS.
2. TOP SURFACE SHALL BE BROOM FINISHED.
3. ALL EXTERNAL EDGES NOT LABELED SHALL BE TROWELED WITH 1/4" RADIUS EDGER.
4. INLETS SHALL BE SPACED CONSISTENT WITH CATCH BASIN SPACING REQUIRED IN THE STORM WATER MANUAL.
5. WHERE CURB INLETS ARE USED, APPROX. 6 INCHES OF ROCK OR OTHER EROSION PROTECTION MATERIAL SHALL BE USED TO DISSIPATE ENERGY AND/OR FLOW DISPERSION.
6. PERVIOUS PAVING MAY BE USED FOR INLET WITH CITY APPROVAL.



Scale: NTS
Date: 05/20/09

CURB INLET DETAIL BIORETENTION SWALE

LID-07

APPROVED BY

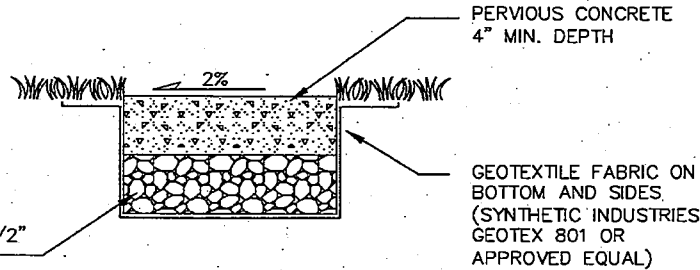
CITY OF SEQUIM ENGINEER

DATE

NOTES:

1. GEOTEXTILE FOR UNDERGROUND SEPARATION REQUIRED ONLY ON TYPE "C" AND "D" SOILS.
2. SUBGRADE SHOULD NOT BE COMPACTED.

4" MIN. DEPTH 1-1/2"
-3" WASHED ROCK

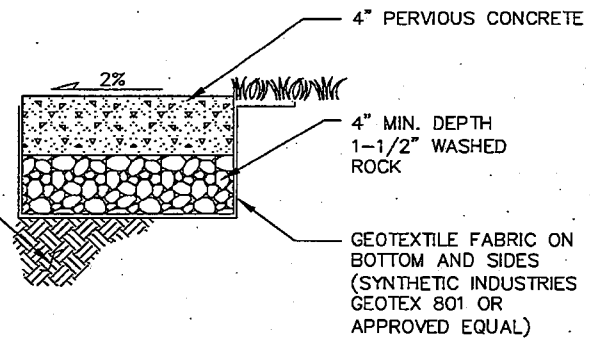


PERVIOUS CONCRETE SIDEWALK

REMOVE UNSUITABLE
MATERIAL AND COMPACT
SUBGRADE TO 90% OF
MAXIMUM DRY DENSITY

NOTES:

1. GEOTEXTILE FOR UNDERGROUND SEPARATION REQUIRED ONLY ON TYPE "C" AND "D" SOILS.



PERVIOUS CONCRETE SURFACING

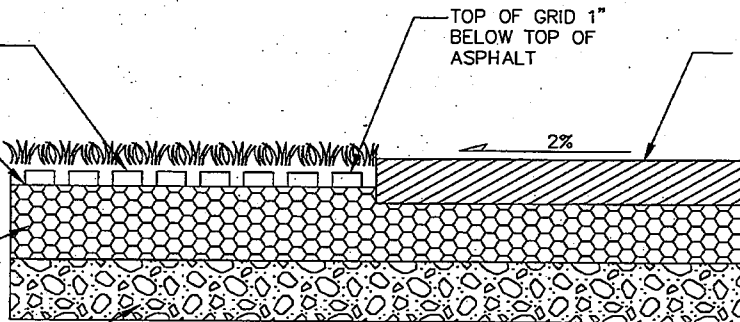
DRIVABLE PERVIOUS SURFACING: DRIVE LANE, SHOULDERS, ON-STREET PARKING

MODULAR PLASTIC
GRID SYSTEM I.E.
GRASS PAV OR
EQUIVALENT

FILL GRID WITH
SANDY LOAM
TOPSOIL MIX

4" MIN. COMPACT
DEPTH CRUSHED
SURFACING TOP
COURSE

4" MIN. COMPACT
DEPTH CRUSHED
SURFACING BASE
COURSE



GRASS PAVING



Scale: NTS
Date: 05/20/09

**LID ALTERNATIVE SURFACING
PERVIOUS PAVING DETAILS**

LID-08

APPROVED BY

CITY OF SEQUIM ENGINEER

DATE



LOW IMPACT DEVELOPMENT

LOCAL REGULATION ASSISTANCE PROJECT 2009

Appendices

- a. Background on the LID Draft Chapter/LID Performance Standards Table*
- b. Guidance for Determining When LID Should Not Be Required*
- c. Ecoroof Questions and Answers (City of Portland)*
- d. Frequently Asked Questions About LID*
- e. Gravelpave2 Maintenance Guide (by Invisible Structures)*
- f. Grasspave2 Maintenance Guide (by Invisible Structures)*
- g. LID Best Management Practices (brochure in binder pocket)*
- h. LID Economic Factsheet (WECO)*
- i. LID Info Packet (APA)*
- j. LID Incentives*
- k. Maintenance of Low Impact Development Facilities*
- l. Pervious Concrete (brochure in binder pocket)*
- m. Protection of LID IMPs During Construction*
- n. Reducing Stormwater Costs (EPA Full Report)*
- o. SEA Streets Cost Comparison Chart*
- p. SEA Streets Operation and Maintenance Cost Estimates*
- q. Stormwater Monitoring Two Ecoroofs in Portland, Oregon*
- r. Stormwater Utility User Fee Credits (Stormwater Journal article)*
- s. Standard Test Methods for Pervious Pavements*
- t. Tree Species (Recommended)*
- u. Vegetated Roof Cover Philadelphia, Pennsylvania (a Green Roof Study by the Environmental Protection Agency)*

BACKGROUND ON THE LID DRAFT CHAPTER: Methodology for the Stormwater Detention Volume Reductions, Native Vegetation Retention, and Maximum Impervious Surface Standards Table

The standards for minimum stormwater detention volume reductions in the low impact development (LID) table were developed based on a combination of soil infiltration rates, assumptions about the average densities in various rural, urban, commercial, and industrial settings, and the results of stormwater modeling scenarios using Western Washington Hydrology Model (WWHM) software.

The initial standard evaluated was Department of Ecology's 65/10/0 rule for allowing full dispersion of developed project runoff. The 65/10/0 standard was meant to apply to rural settings where the standards include: a minimum of 65% vegetation preserved or replanted, a maximum of 10% impervious surface coverage, and 0% effective impervious surface coverage. During preliminary conversations between AHBL, the Puget Sound Partnership (PSP), Washington State University Extension, and Department of Ecology it was determined that the 65/10/0 rule was likely an unattainable goal in most urban development scenarios. Therefore, the project team worked to develop a sliding scale of stormwater management goals with the understanding that the minimum LID standards must balance urban density requirements mandated under the Growth Management Act (GMA), while minimizing the impacts of stormwater runoff to receiving waters.

The project team consensus was that maintaining a percentage of the development site in native open space should be a primary goal of LID projects. The minimum native vegetation retention and maximum impervious surface standards in the table were developed by reviewing existing coverage limitations in a variety of jurisdictions for different zone designations and by assuming reasonable additional requirements for an LID project taking into account typical lots in a variety of rural, commercial, and industrial zones.

The reduction in conventional detention storage volumes required for a project was developed by modeling several development scenarios using WWHM and applying assumptions intended to mimic a typical development. The modeling was done for both commercial and residential developments with varying densities. In order to calculate detention volume reduction, it is necessary to calculate the required detention storage volume for a conventionally designed project. Therefore, a second table was developed to give the designer assumed conventional surface areas for modeling. This second table was developed based on similar impervious surface tables found within several adopted stormwater management manuals. The project goals were further defined by assuming different average site soil infiltration rates and determining how that affected reductions in detention volume that could be obtained through reasonable LID implementation (i.e., implementation of commonly used LID techniques such as bioretention and pervious pavement). The following section details several of the project scenarios and assumptions that were modeled for the development of the LID tables. All modeling was conducted using guidance from Chapter 7 of the *LID Technical Guidance Manual*

*Prepared by AHBL for the Puget Sound Partnership's LID Local Regulation Assistance Project
Modeling was conducted in 2005. This document was written in June 2009*

for Puget Sound, 2005 and Appendix III-C of the Stormwater Management Manual for Western Washington, 2005.

Modeling Scenarios/Assumptions/Detention Volume Reductions

4 DU/ACRE (gross)

Total Site Area = 435,600 sf (10.000 ac)

Native Growth Area = 152,460 sf (3.500 ac)

Dispersed Area = 27,240 sf (0.625 ac)

Total Area Input to Model = 255,900 sf (5.875 ac)

Road Area = 28,424 sf (0.653 ac)

(24 foot impervious road with 2-40' radius cul-de-sacs)

Public Sidewalk = 6,400 sf (0.147 ac)

(Pervious surface modeled as 3,200 sf impervious and 3,200 sf landscape)

Driveways

$$24(18' \times 24') + 16(18' \times 29') = 18,720 \text{ sf}$$

(Pervious surface modeled as 9,360 sf impervious and 9,360 sf landscape)

Private Walkways & Patio

$$34(300 \text{ sf}) + 40 (30' \times 3') = 13,800 \text{ sf}$$

(Patios from 6 lots assumed to be fully dispersed in native growth area. Pervious surface modeled as 6,900 sf impervious and 6,900 sf landscape)

Roof Area

$$34(1,650 \text{ sf}) = 56,100 \text{ sf}$$

(Roof Area from Lots 12 – 17 assumed to be fully dispersed in native growth area)

Swale Area

685 lf – 16(27') for driveways + 172 for center of c.d.s. = 425 lf

Swale is assumed 4 ft bottom width with 3:1 side slopes and a total depth of 18 inches and a max design depth of 9 inches. Swale is lined with a minimum of 2 feet of engineered soil mix.

Center of c.d.s. bottom radius if 10.5' with area of 346 sf equivalent to 86 lf of swale with 4' bottom width. Two c.d.s. results in total additional swale length of 172 lf.

8.5'x425' = 3,612 sf pond area

13'x425' – 3,612 sf = 1,913 sf pasture

Detention Pond Area

10,890 sf (0.250 ac) pond

Remaining Landscape Area

255,900 sf – (28,424 + 6,400 + 18,720 + 13,800 + 56,100 + 5,525 + 10,890) =
116,041 sf (2.664 ac)

Assume 25% of the area is pasture for soil rehabilitation.

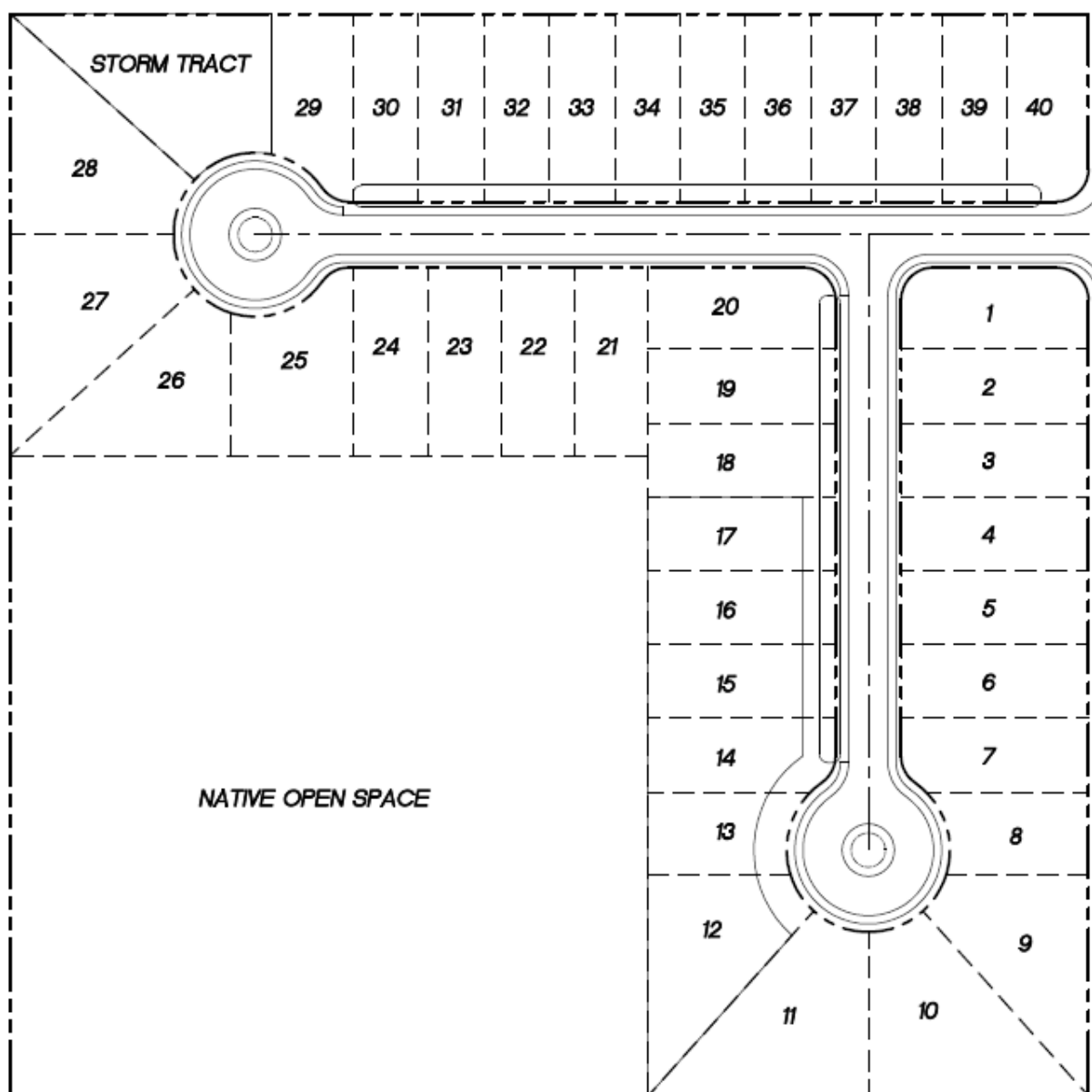
WWHM Inputs

	Impervious (ac)	Landscape (ac)	Pasture (ac)	Pond (ac)	Forest (ac)	Total (ac)
Pre-LID	-	-	-	-	5.875	5.875
Post-LID	2.387	2.445	0.710	0.333	-	5.875
Pre-Conventional	-	-	-	-	10.000	10.000
Post-Conventional	3.885	5.365	-	0.750	-	10.000

Results

	0.05 in/hr	0.10 in/hr	0.30 in/hr	1.00 in/hr
Conventional (ac-ft)	2.902	2.902	2.902	2.902
LID (ac-ft)	1.460	1.353	1.067	0.599
% Reduction	49.69%	53.38%	63.23%	79.36%

The drawing below is meant to be a very rough schematic of site and storm features. This drawing reflects a concept site with assumptions made on layout and topography. As such, the drawing was not modified or fine tuned for each site scenario modeled.



6 DU/ACRE (gross)

Total Site Area = 435,600 sf (10.000 ac)

Native Growth Area = 87,120 sf (2.000 ac)

Dispersed Area = 21,730 sf (0.499 ac)

Total Area Input to Model = 326,750 sf (7.501 ac)

Road Area = 29,384 sf (0.675 ac)

(24 foot impervious road with 2-40' radius cul-de-sacs)

Public Sidewalk = 6,602 sf (0.147 ac)

(Pervious surface therefore modeled as 3,301 sf impervious and 3,301 sf landscape)

Driveways

$$35(18' \times 24') + 25(18' \times 29') = 28,170 \text{ sf}$$

(Pervious surface therefore modeled as 14,085 sf impervious and 14,085 sf landscape)

Private Walkways & Patio

$$50(300 \text{ sf}) + 60 (30' \times 3') = 20,400 \text{ sf}$$

(Patios from 10 lots assumed to be fully dispersed in native growth area.
Pervious surface therefore modeled as 10,200 sf impervious and 10,200 sf landscape)

Roof Area

$$45(1,200 \text{ sf}) = 54,000 \text{ sf}$$

(Roof Area from 15 lots assumed to be fully dispersed in native growth area)

Swale Area

$$725 \text{ lf} - 25(27') \text{ for driveways} + 116 \text{ for center of c.d.s.} + 100 \text{ for rain garden} = 266 \text{ lf}$$

Swale is assumed 6 ft bottom width with 3:1 side slopes and a total depth of 18 inches and a max design depth of 9 inches. Swale is lined with a minimum of 2 feet of engineered soil mix.

Center of c.d.s. bottom radius if 10.5' with area of 346 sf equivalent to 58 lf of swale with 6' bottom width. Two c.d.s. results in total additional swale length of 116 lf.

Add rain garden prior to detention pond. Assume 600 sf bottom area, equivalent to 100 lf of swale.

Detention Pond Area

16335 sf (0.375 ac) pond

Remaining Landscape Area

$326,750 \text{ sf} - (29,384 + 6,602 + 28,170 + 20,400 + 54,000 + 15,720) = 172,474 \text{ sf}$ (3.959 ac)

Assume 25% of the area is pasture for soil rehabilitation.

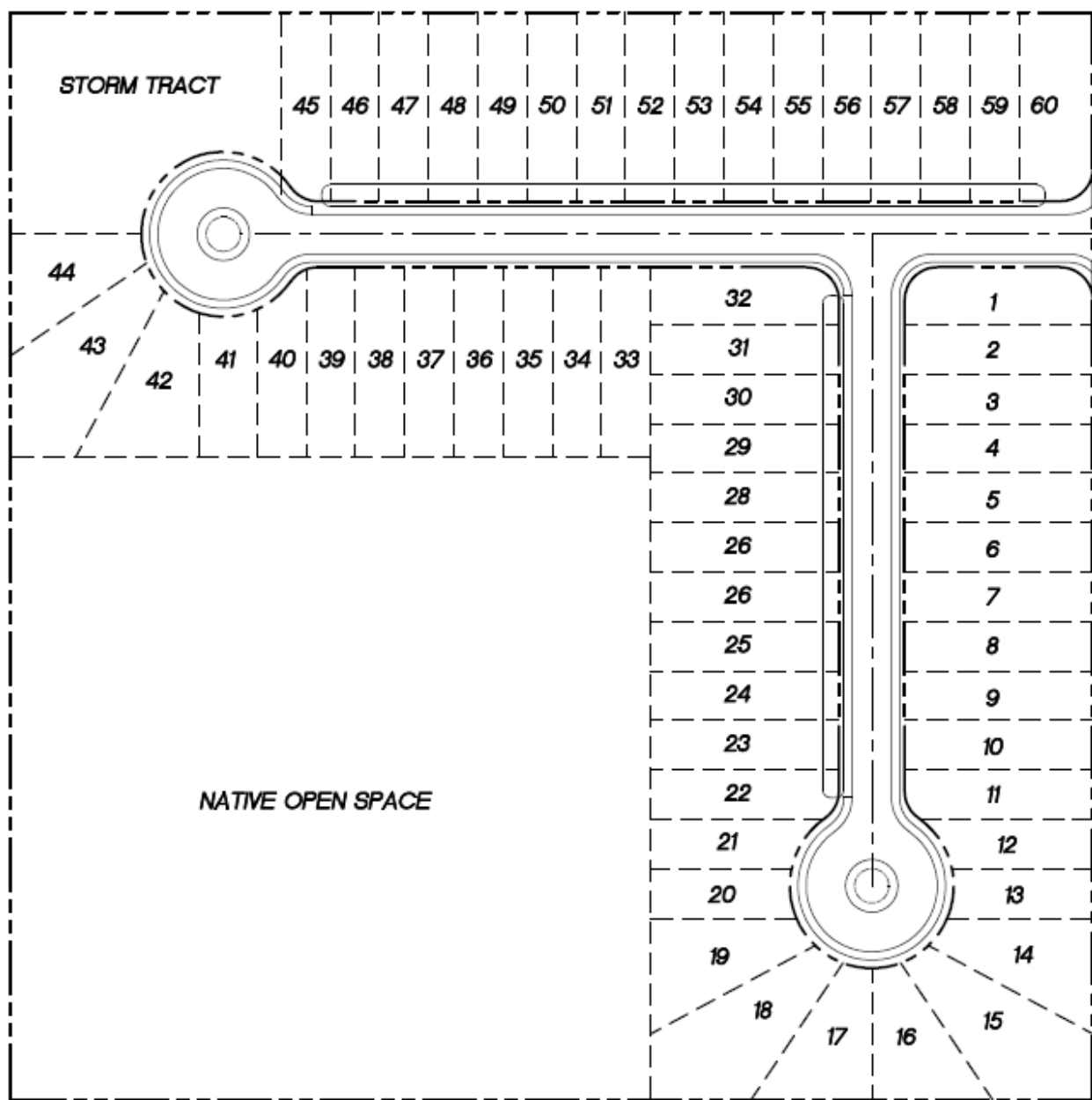
WWHM Inputs

	Impervious (ac)	Landscape (ac)	Pasture (ac)	Pond (ac)	Forest (ac)	Total (ac)
Pre-LID	-	-	-	-	7.501	7.501
Post-LID	2.547	3.589	0.990	0.375	-	7.501
Pre-Conventional	-	-	-	-	10.000	10.000
Post-Conventional	5.000	5.000	-	-	-	10.000

Results

	0.05 in/hr	0.10 in/hr	0.30 in/hr	1.00 in/hr
Conventional (ac-ft)	3.062	3.062	3.062	3.062
LID (ac-ft)	1.862	1.813	1.585	1.108
% Reduction	39.19%	40.79%	48.23%	63.81%

The drawing below is meant to be a very rough schematic of the site and storm features. This drawing reflects a concept site, as many assumptions were made on layout and topography. As such, the drawing is not scaled or fine tuned for each site scenario modeled.



Commercial

Total Site Area = 87,120 sf (2.000 ac)

Native Growth Area = 8,712 sf (0.200 ac)

Total Area Input to Model = 78,408 sf (1.800 ac)

Roof Area = 15,200 sf (0.349 ac)

Sidewalk = 4,050 sf (0.093 ac)

(Pervious surface therefore modeled as 2,025 sf impervious and
2,025 sf landscape)

Pavement Area = 32,737 sf (0.752 ac)

Swale Bottom Area = 4,400 sf

(equivalent to 8'x550' swale, 6,050 sf pond 2,200 sf pasture)

Detention Pond Area = 6,000 sf

Remaining Landscape Area

$$78,408 \text{ sf} - (15,200 + 4,050 + 32,737 + 6,050 + 2,200 + 6,000) = 12,171 \text{ sf}$$

WWHM Inputs

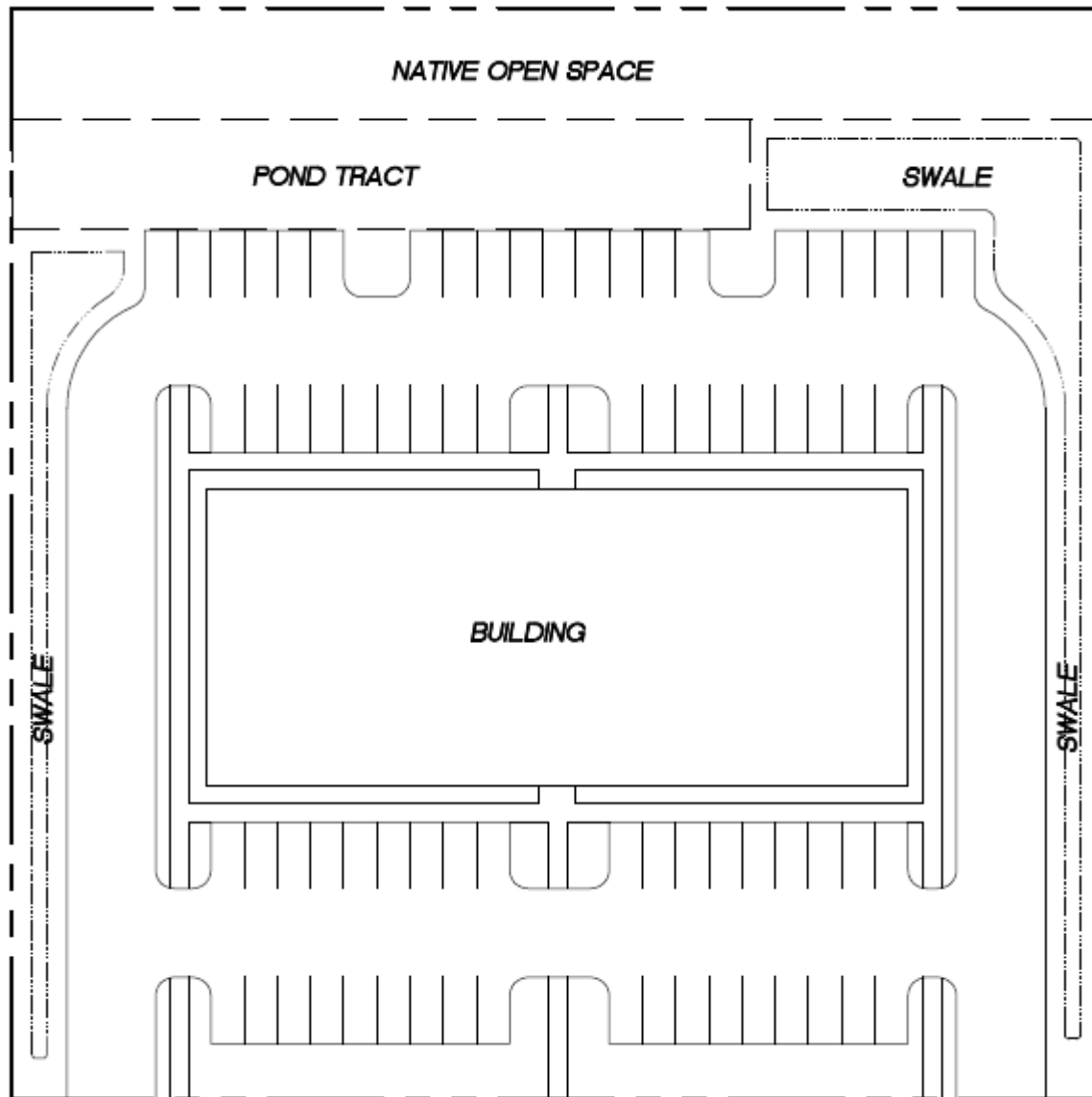
	Impervious (ac)	Landscape (ac)	Pasture (ac)	Pond (ac) [1]	Forest (ac)	Total (ac)
Pre-LID	-	-	-	-	1.800	1.800
Post-LID	1.147	0.326	0.050	0.277	-	1.800
Pre-Conventional	-	-	-	-	2.000	2.000
Post-Conventional	1.295	0.555	-	.15.	-	2.000

1: The post-LID pond area is larger than the post-Conventional pond area because the swale area was input into an older version of WWHM as pond area, as shown in the swale assumptions above, in addition to the conventional detention pond that is required. At the time that this modeling was performed, the live storage area of the swales needed to be designated as pond area in the basin description. The current WWHM3 model allows the swale areas to be defined as a detention facility that provides infiltration and receives direct precipitation and evapotranspiration. Therefore, the swale areas do not need to be included as ponds in the basin description, resulting in a smaller defined pond area in the LID scenario.

Results

	0.05 in/hr	0.10 in/hr	0.30 in/hr	1.00 in/hr
Conventional (ac-ft)	0.795	0.795	0.795	0.795
LID (ac-ft)	0.496	0.381	0.168	0.000
% Reduction	37.61%	52.01%	78.87%	100%

The pond is eliminated in the 1 inch per hour scenario resulting in a swale equivalent length of 1000 feet. The rough site plan below depicts the scenario for 0.3 in/hr and below. The drawing is meant to be a very rough schematic of the site and storm features. This drawing reflects a concept site, as many assumptions were made on layout and topography. As such, the drawing is not modified or fine tuned for each site scenario modeled. The model that the rough schematic is based on, was derived from a single swale length for the 0.05 through 0.3 in/hr. A pond was not needed for the 1.00 in/hr, and it was therefore removed from the assumptions and swale was added where the pond was assumed for the other scenarios.



Commercial Project #2

The following is an analysis of Low Impact Design techniques for a typical strip-mall type commercial development. The proposed site plan is based on an actual commercial development in Pierce County. The following assumptions were used:

- The Western Washington Hydrology Model (WWHM) was used to predict stormwater runoff rates and volumes.
- The site is assumed to be located in Kirkland.
- Site soils are assumed to be till with a long term design infiltration rate of 0.25 inches per hour.
- Pervious pavements are modeled as 50% impervious surface and 50% grass.
- Green roofs are modeled as 50% impervious and 50% grass.
- Detention is provided via an underground vault within the pavement area.
- Existing conditions are modeled as forest.
- Proposed conditions are based on the attached site plan. The areas are summarized in the table below.

Surface Type	Area (acre)
Building Roof Area	0.156
Sidewalk Area	0.043
Asphalt/Concrete Area	0.467
Landscape Area	0.254
Total Area	0.920
% Impervious	72.39%

Five scenarios were modeled; the following is a description of each scenario:

Scenario #1 – This scenario assumes standard asphalt and concrete pavements drained to a conventional conveyance system.

Scenario #2 – Perimeter landscaped areas are depressed to function as rain gardens (bio-retention). A bottom surface area of 1500 square feet is assumed with a maximum surface ponding depth of 6-inches. The rain gardens are lined with 18-inches of treatment soil with a **void ratio of 40% resulting in a total effective storage depth of $(0.4 \times 18") + 6" = 13.2$ inches (1.1 feet)**

Scenario #3 – Pervious pavements are used for driving and parking surfaces. The sidewalk around the building is impervious concrete. No bio-retention is provided.

Scenario #4 – This scenario is a combination of #2 and #3.

Scenario #5 – Is the same as #4 with the addition of a green roof.

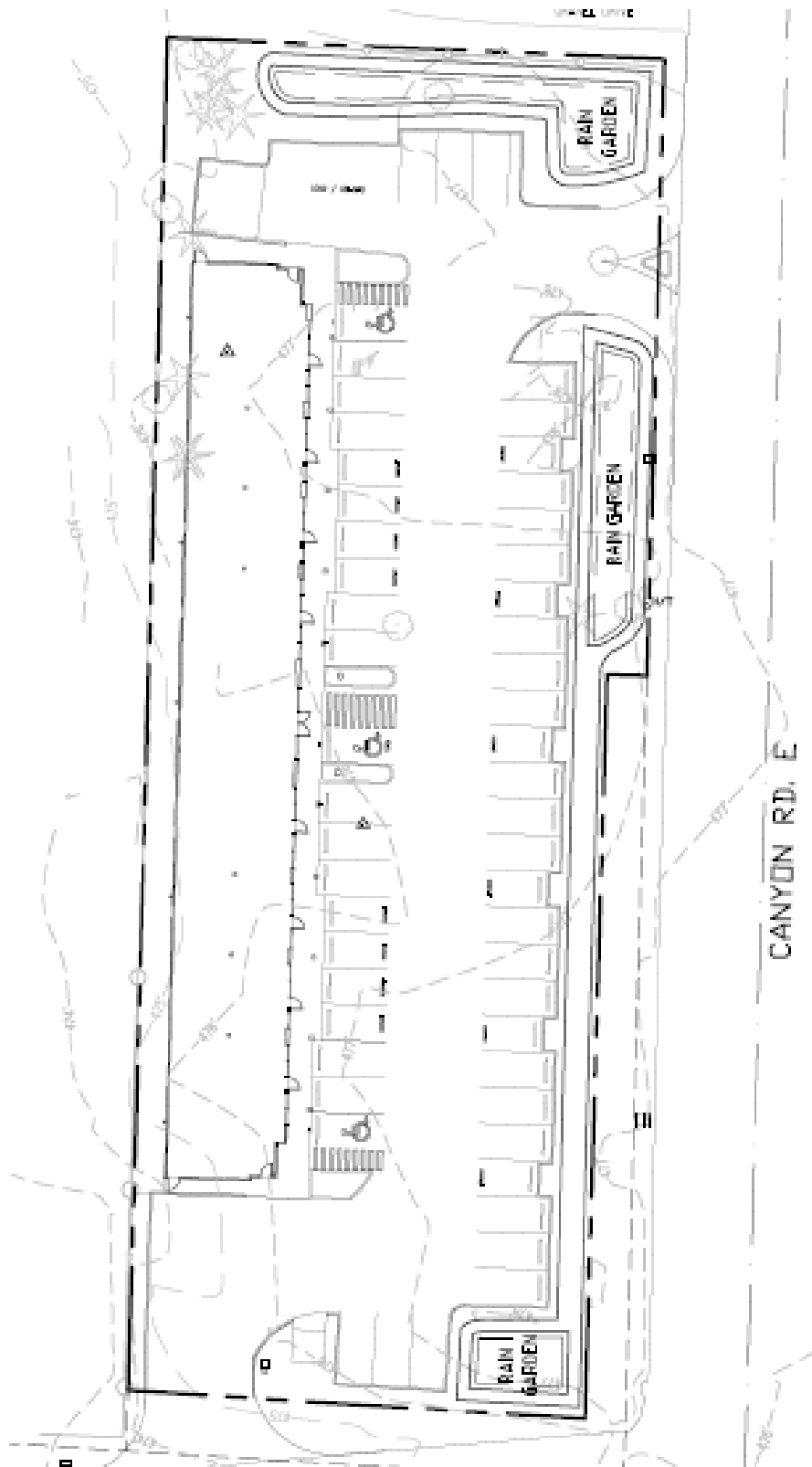
The following table summarizes required detention volumes for each scenario.

Scenario	Detention Volume (cf)	% Reduction
#1	13,035	n/a
#2	7,795	40.20%
#3	9,576	26.54%
#4	4,713	63.84%
#5	4,758	63.50%

Scenario #5 appears to show that the detention volume reduction benefit of the green roof for this particular site plan is minimal, and within the error range for the model.

Treatment requirements were not analyzed.

The drawing below is meant to be a very rough schematic of the site and storm features. This drawing reflects a concept site, as many assumptions were made on layout and topography. As such the drawing is not scaled or fine tuned for each site scenario modeled.



STORMWATER MONITORING TWO ECOROOFs IN PORTLAND, OREGON, USA

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City of Portland, Bureau of Environmental Services

Abstract

Ecoroofs, long used in Europe to reduce stormwater runoff from rooftops, are beginning to be installed in North America. When the City of Portland, Bureau of Environmental Services (BES) began considering ecoroofs for stormwater management, no applicable performance data could be located. To generate region-specific data, BES initiated a monitoring project of an apartment building vegetated with two different ecoroofs. After over two years of water quality monitoring and over a year of flow monitoring, some impressive performance has been measured. Precipitation retention has been calculated at 69% for the 4-5 inch ecoroof substrate section and nearly all of the rainfall is absorbed during dry period storm events. Stormwater detention and peak intensity attenuation has also been impressive even when the roof was saturated during winter months. Some water quality benefits have proven more difficult to quantify but important water quality lessons have been learned. In situations where a receiving water system may be sensitive to certain pollutants, substrate composition will be an important consideration in the ecoroof design. Our work to date has proven that ecoroofs can be an effective urban stormwater management tool. The next major endeavor will be to apply this information to system modeling efforts to determine hydrologic and hydraulic infrastructure and stream benefits that may be achieved. This information is also expected to assist bureau managers, planners, engineers and elected officials with policy decisions, such as zoning density bonuses, infrastructure designs, drainage fee discounts, and code compliance.

Introduction

The City of Portland, Bureau of Environmental Services (BES) manages Portland's sewers and stormwater infrastructure, and is responsible for watershed planning to improve and protect human health and the natural environment. Portland's rapid development and plentiful rainfall have moved stormwater management to the forefront of BES's priorities.

Greenroofs have been used for stormwater management over the past several decades in Europe. In the mid-1990s, BES became interested in investigating the potential of using greenroofs or 'ecoroofs' for stormwater management in general, and specifically to reduce storm flows to our aging and overburdened sewer infrastructure. (*Terminology note - Portland decided to use the term 'ecoroof' to describe an extensive, self-sustaining green roof, due to their multiple ecological attributes.*) Since there was no monitoring data from North American ecoroof projects and it was unclear if these roofs would perform well in our wet and mild climate, BES decided to pursue building and monitoring an ecoroof demonstration project to evaluate its effectiveness.

After monitoring a small-scale ecoroof project on a residential site, which yielded promising results, we decided to fund a full-scale test on a larger building. This paper discusses findings from this project, Hamilton Apartments Building.

Ecoroof Overview

An ecoroof is a living vegetated ecosystem of lightweight soil and self-sustaining vegetation. It is biologically 'alive' and as such provides a protective cover on the building by using the natural elements of sun, wind, and rain to sustain itself. Ecoroofs require little maintenance and provide an aesthetic alternative, with many economic and ecological attributes not found in a conventional roof. Figure 1. shows the main ecoroof components including a waterproof membrane or material that prevents water from entering the building; drainage material such as geotextile webbing that allows water to flow to the drains when the substrate is saturated; and soil or substrate (growing medium) as light as 6 pounds per square foot (psf).

The City of Portland chose to use the term 'ecoroof' to describe its "green" roof program for several reasons. First, the western United States including most of Oregon and Washington has dry hot summers and may not receive precipitation for many months. Native plants although more self-sustaining often do not remain "green." A "not green" or brown roof does not imply that the vegetation has died, thus the prefix eco (for ecosystem) was chosen as being more descriptive of what the ecoroofs are intended to achieve. Another reason was the many references to the economic value, especially the longer life, thus eco also refers to the economic benefits.

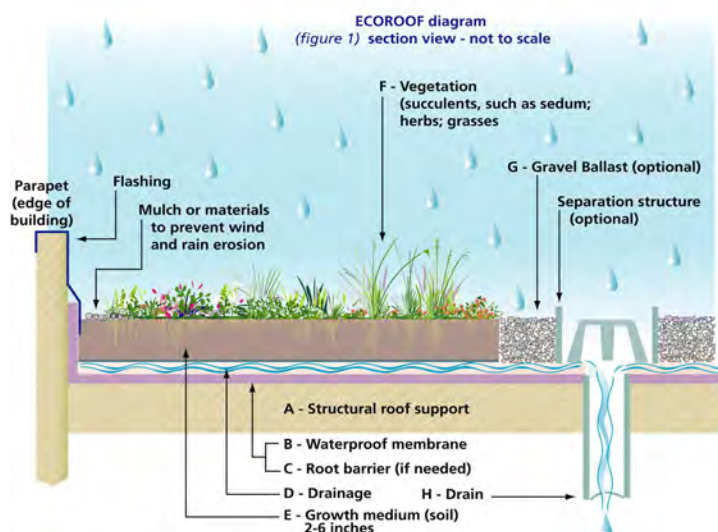


Figure 1. Ecoroof Cross Section

Portland Overview and Weather

Portland is a city of about 500,000 residents and covers an area of 135 square miles. It is located at the northern end of the Willamette Valley in northwest Oregon. In its predevelopment state, it was covered with some of the largest coniferous trees in the world. Today, like most other cities, it has removed almost all of the natural forests to provide habitat for people. This human habitat takes shape in two primary building blocks, rooftops and pavement. Although rooftops constitute only one type of surfacing, they represent about 40% of all impervious surfaces in the City. At full build-out based on current zoning, rooftops are likely to cover more than 25 square miles of the city.

Portland is characterized by a mild climate, with moderate but near-continuous winter rainfall, dry summers, and occasional low-elevation snowfall. The Portland climate provides ideal growing conditions for a multitude of plants. However, prolonged summer dry periods, typical for the region, presents one of the greatest challenges to plant survivability. The dry period typically begins in mid-June and lasts through the end of September.

Average annual rainfall in Portland, Oregon is 37 inches, with average rainfall in July and August at 0.7 and 0.8 inches, respectively. Table 1 shows rainfall for a 5-year period beginning 1997. Note that for the past 5 years, the average July and August combined rainfall has only

been 0.8 inches. For the same time period in 2002, total rainfall was 0.28 inches, and September plus October totaled only 1.4 inches. Although rain does occur in summer, it is not unusual to have 30-60 consecutive days of no precipitation. Total rainfall over the course of 123 consecutive days was 1.68 inches from July-October, 2002. Normal summer temperature highs range from 70's to 90's F and can reach 100 F for short periods. Normal winter temperature lows often are in the 20's F, but average in the mid 30's F.

Season	1997-98	1998-99	1999-00	2000-01	2001-02	Average
Wet (Oct.-May)	41.1	47.93	32.24	18.91	32.22	34.48
Dry (June-Sep.)	2.93	3.8	3.32	3.01	2.74	3.16
July & August only	(0.40)	(1.55)	(0.45)	(1.34)	(0.28)	(0.80)
Total	44.03	51.73	35.55	21.91	34.96	37.64

Table 1. Rainfall (inches) for Portland Oregon (Source BES HYDRA-SYSTEM)

Hamilton Ecoroof Project

As stated above, BES wanted to establish a full-scale ecoroof project on a large building to test its effectiveness. The Housing Authority of Portland, in cooperation with BES, built the Hamilton Apartment's ecoroofs in the autumn of 1999 as a demonstration and testing facility. BES is monitoring this ecoroof to determine characteristics of planting methods; viability of substrate and vegetation; and effluent water quality and stormwater retention characteristics of two different ecoroof substrate mixtures and thickness.

Ecoroof Descriptions

The Hamilton Apartments is a ten-story, 8,700 square foot (sf) building. The ecoroof was installed in September 1999. For research purposes, the ecoroof was divided into two sides – east and west. The east side consists of 2520 sf of vegetated cover with initial substrate depth of 3 inches (now 2 inches). The east substrate is composed of 15% digested fiber, 25% encapsulated Styrofoam (EPS), 15% perlite, 15%



Figure 2. Hamilton East Ecoroof May 2002

course peat moss and 15% compost. Saturated weight of the east substrate is 10 pounds per square foot (psf) for the original 3-inch depth. The west side consists of 2620 sf of vegetated cover with initial substrate depth of 5 inches (now 4-4.5 inches). The west substrate consists of 20% digested fiber, 10% compost, 22% course perlite and 28% sandy loam. Saturated weight of the west substrate is 25 psf for the original 5-inch depth. As of 2003, approximately one inch of substrate was lost on both sides due to wind erosion. An automatic irrigation system with spray heads on 12-inch risers was installed to water during dry periods. The irrigation system was installed to assure plant establishment, the long-term goal is to eliminate the need for irrigation. For example during the summer of 2001, about 6 and 4 inches of water was applied to the east and west sides, respectively; and in 2002 about 3 and 2 inches, respectively).

Over 75 species of plants were installed in an identical arrangement on each ecoroof. Plant species included a wide variety of succulents such as sedum, delosperma and sempervivum, numerous grasses and other herbaceous species. These two identical vegetative arrangements have evolved into different plant communities. Many of the original plants died and numerous grasses have colonized the ecoroofs, but each side remains distinctly different.

As precipitation falls onto the building it flows laterally towards a set of primary and secondary roof drains located near the center of each of the two roof sections. The east drains have a total drainage catchment of 3,811 sf. This east catchment area consists of 2,520 sf of vegetated ecoroof (66%) and 1,291 sf of various impervious surfaces (34% impervious). The west drains have a total drainage catchment of 3,655 sf. This catchment area consists of 2620 sf of vegetated ecoroof (72%) and 1,035 sf of various impervious surfaces (28% impervious). For both sides, the various impervious surfaces include vents, parapet walls, gravel on roof membrane, and terrace pavers installed over a 1.5-inch sand base to help absorb moisture.

There is a conventional roof on a 1,239 sf penthouse containing building heating and cooling equipment. In December 2001 all downspouts from the penthouse were plumbed directly to the primary roof drains so that conventional roof runoff would not combine with the vegetated areas. However, it is suspected that during high intensity storm events a 342 sf section of the



penthouse roof drains into the east ecoroof due to lack of continuous gutters around the conventional roof. See discussion concerning rainfall/runoff discrepancies. Figure 3 shows the roof layout.

Monitoring Methodology

The following sections present methods used for monitoring: substrate, flow and rainfall, and water quality.

Substrate Sampling

Prior to installing of the ecoroofs, the roof contractor provided samples of each of two substrate mixtures to the BES. BES stored these samples until 2001 when they were sent to the BES Water Pollution Control Laboratory for analysis. The purpose of the testing was to assist in correlating stormwater runoff quality with substrate composition.

Flow and Rainfall Monitoring System

BES Field Operations staff installed flow-monitoring equipment in December 2001. A small, 60-degree, V-trapezoidal Plasti-Fab flume is installed adjacent to, and immediately upstream of, each primary roof drain. The primary roof drain is sealed and isolated to direct all flow through the flume prior to entering the drain. An American Sigma Model 950 bubbler-type flow meter is used to measure water level in each flume. Level data are converted to flow values by using a formula created by manually establishing the level to flow relationship specific to these flumes. (Initial monitoring indicated that the formula provided for the flumes by the manufacturer was not accurate enough for this project so BES calculated a more accurate formula).

The primary roof drains are plumbed directly to the City storm sewer system. The adjacent secondary drains are installed as emergency overflow drains if the primary drains become plugged. Since the secondary drains are fitted with a two-inch extension collar, water will only enter the secondary drains if the pooled water level around the drains exceed 2.9 inches on the east side and 2.4 inches on the west side. The possibility exists that during very large storms, some water may flow out the secondary drain and not flow through the flume. (To date, there has been only one storm that created enough runoff to cause overflow to the west secondary drain.) The secondary drains discharge directly off the side of the building. Drainage from the conventional roof enters the primary drains immediately downstream from the flume outlets and is not monitored.

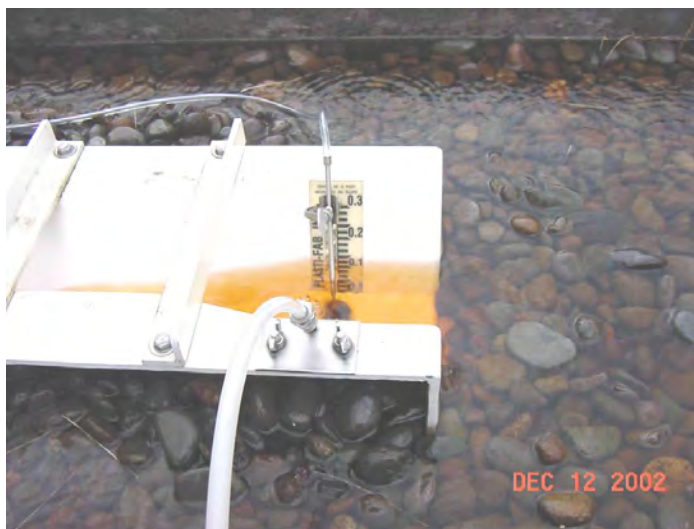


Figure 4. Flow monitoring station photographs. The left shows the flume and flow monitor and the right shows a close-up of the flume during a storm event.

A Hydrological Services tipping bucket rain gauge is installed atop the conventional roof in the center of the building to ensure that accurate rain data are collected for the site. Rain data are collected and relayed via radio telemetry to a networked computer (HYDRA-system). Rain data are converted to a rain run-on flow rate for each side by multiplying rainfall by the catchment area.



Figure 5. Rain gauge and antenna in upper right.

Water Quality Monitoring

Sampling Procedures

BES Field Operations collect stormwater runoff grab samples by placing a decontaminated stainless steel beaker or the analysts-specific sample containers directly under the flow

discharging from the flumes. The minimum storm criteria for water quality analysis for this project was 0.25 inches of rain in 24 hours to ensure adequate runoff volumes. Grab samples are collected during the middle to latter part of storm events. As of April 2003 eight storms have been monitored for water quality (data is only available from seven events).

Analytical Parameters

Samples are analyzed in the field for dissolved oxygen, pH, specific conductance, and temperature using portable field meters. Samples are submitted to the BES Water Pollution Control Laboratory for analysis of ammonia-nitrogen, biochemical oxygen demand, chemical oxygen demand, color, total and dissolved metals (arsenic, cadmium, copper, lead, silver, and zinc), *Escherichia coli*, orthophosphate-phosphorus, total phosphorus, and total suspended and dissolved solids.

Vegetation and other Monitoring

On a regular basis, visual observations and photo-documentation of various conditions and activities of the ecoroof and entire rooftop area are made. Vegetation, substrate, wildlife and human activities are tracked to allow BES an opportunity to understand what affects stormwater management performance. Other issues, such as energy and air quality will be considered for monitoring in the future, either on this project or perhaps other ecoroofs under construction at this time.

Monitoring Results

Substrate Composition

Table 2 shows the substrate chemical composition for the parameters listed. The ratio column indicates the relationship between the east and west substrate. For all parameters, except total arsenic, the west substrate has much higher concentrations. The west extractable arsenic is 9 times higher than the east substrate. It should be noted that these results are from samples collected at the time the ecoroof was installed in 1999. Future substrate chemical analysis may be conducted in 2005 to determine if any measurable changes have occurred. In most cases, concentrations are higher for the west substrate compared to the east substrate. In situations where a receiving water system may be sensitive to certain pollutants of concern, substrate composition will be an important consideration in the ecoroof design. See water quality discussion below.

Parameter	Extractant	Method	Unit	East	West	Ratio
Total Arsenic		EPA 200.9	mg/kg	4.54	2.19	0.5
Total Copper		EPA 200.7	mg/kg	17.5	30.3	1.7
Total Lead		EPA 200.9	mg/kg	5.57	64.9	11.7
Total Zinc		EPA 200.7	mg/kg	48.2	146.1	3.0
Extractable Arsenic	DTPA	EPA 200.9	mg/kg	0.01	0.09	9.0
Extractable Copper	DTPA	EPA 200.7	mg/kg	1.25	6.08	4.9
Extractable Lead	DTPA	EPA 200.9	mg/kg	0.26	2.43	9.3
Extractable Zinc	DTPA	EPA 200.7	mg/kg	4.9	64.8	13.2
Extractable Nitrate	1 N KCL	SM 4500-NO3	mg/kg	253.6	798.3	3.1
Extractable Ammonia	1 N KCL	SM 4500-NH4	mg/kg	2.7	28.6	10.6
Total Kjeldahl Nitrogen		EPA 351.4	mg/kg	1897	12802	6.7
Total Phosphorus		EPA 365.4	mg/kg	958	2508	2.6
Extractable Ortho-phosphate Phosphorus	0.5 N NaHCO3	SM 4500 PE	mg/kg	100	325	3.3

Table 2. Hamilton Ecoroof Substrate Composition

Flow and Rainfall

Rainfall Retention (precipitation that ultimately evapotranspires)

The flow attenuation characteristic of each ecoroof was evaluated by comparing rain run-on to runoff to calculate retention. In general, both ecoroofs retained varying amounts of stormwater relative to seasonal influences as shown by Figure 6. However, more runoff than run-on was measured during certain months for the east side. After eliminating potential equipment malfunctions, this discrepancy is attributed to unmeasured run-on flow that comes from a 342 sf section of the conventional roof on the penthouse. We believe this is caused by high intensity storms where the flows bypass the penthouse's non-continuous gutter system and cascades onto the east ecoroof. Due to this discrepancy, only the west rain and flow data will be evaluated here.

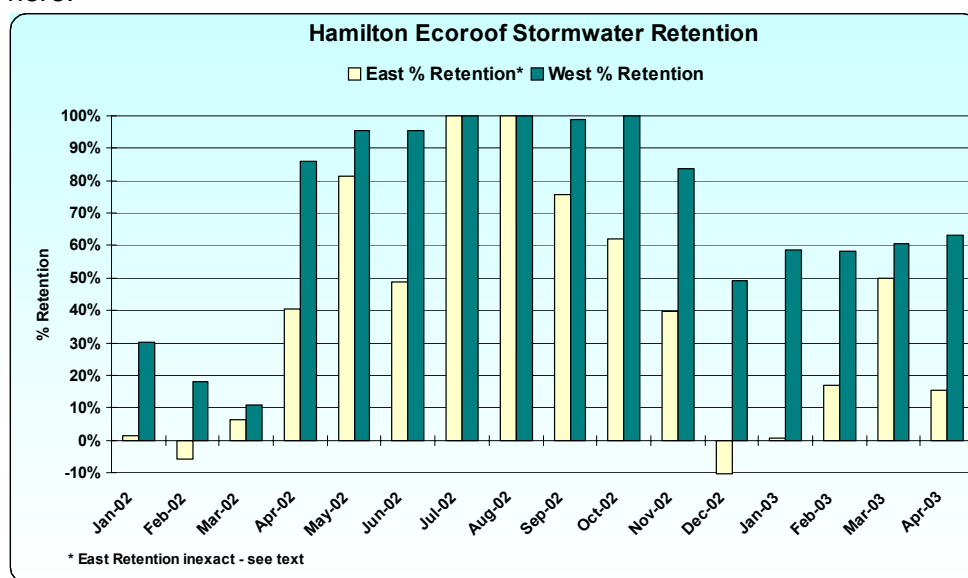


Figure 6. Hamilton Stormwater Retention East vs. West Ecoroofs

West ecoroof retention is shown in Figure 7 for the 15-month monitoring period. Rainfall retention has been calculated using the difference between the rain run-on and runoff volumes. The retention for the west ecoroof during this period is an impressive 69%, which appears to be increasing with time. This apparent increase in retention can be observed by comparing the retention for Jan-March 2002 with Jan – March 2003.

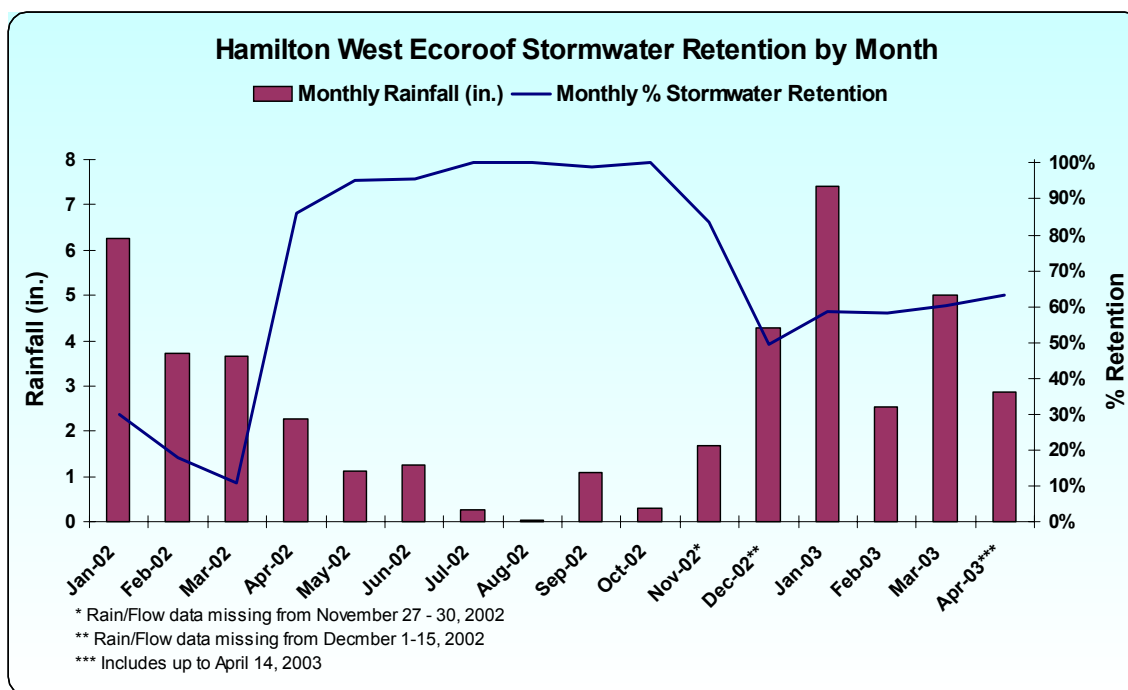


Figure 7 Hamilton West Ecoroof Retention by Month

Comparison of Weather data for winters of 2002 and 2003

The west ecoroof had significantly different retention rates for the months of January, February and March of 2002 and 2003. It is likely there are several factors contributing to the difference in retention from one year to the next. Some factors may include rainfall distribution and intensity patterns, air temperature, vegetation/substrate ecosystem maturity, and perhaps human influences.

The January to March 2002 rainfall retention for the west ecoroof was 20%, and for the same period of 2003 the retention was 59%. The two periods have similar total rainfall amounts of 14.3 and 13.13 inches for 2002 and 2003, respectively. However, the rainfall patterns for the two years are different. 2003 has a greater variability of rainfall and 2002 has more even rainfall distribution. This can be seen in Fig. 8. Note the long dry periods between storms in 2003 and the relatively even rainfall for the same period in 2002. The long dry periods may account for greater evapotranspiration and increased water holding capacity in the ecoroof. 2002 does have some long dry periods as well near the end of February and March. Interestingly, 2002 has 40 dry days and 2003 has only 39 for the three-month period.

The daily average temperatures for the three months in 2002 and 2003 are plotted in Figure 9. It's difficult to see any pattern in the data, until a linear best-fit line is added. This clearly shows

the average daily temperature in 2003 was higher than in 2002 for the same period. The average daily difference was 2.4 degrees Fahrenheit. The effect of this temperature difference and the potential evapotranspiration may account for the higher 2003 retention rates. The last, and potentially most significant, factor that contributed to the increased retention between 2002 and 2003 is the vegetation maturity.

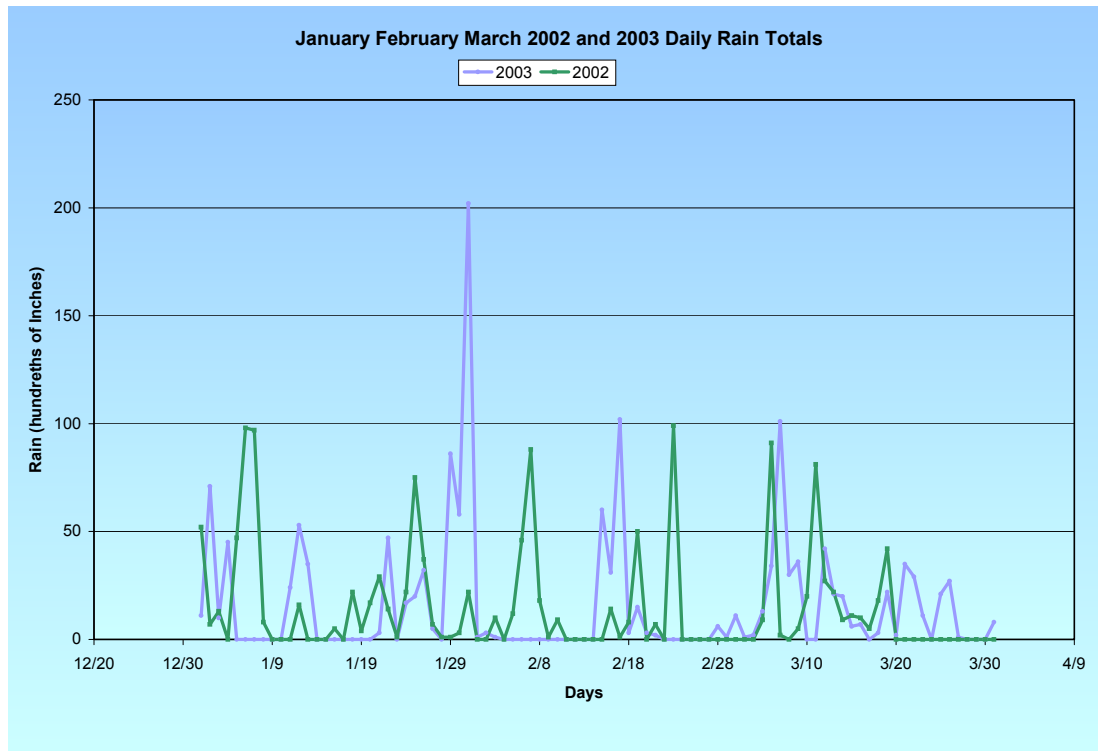


Figure 8. Daily Rainfall for January, February and March – Years 2002 and 2003

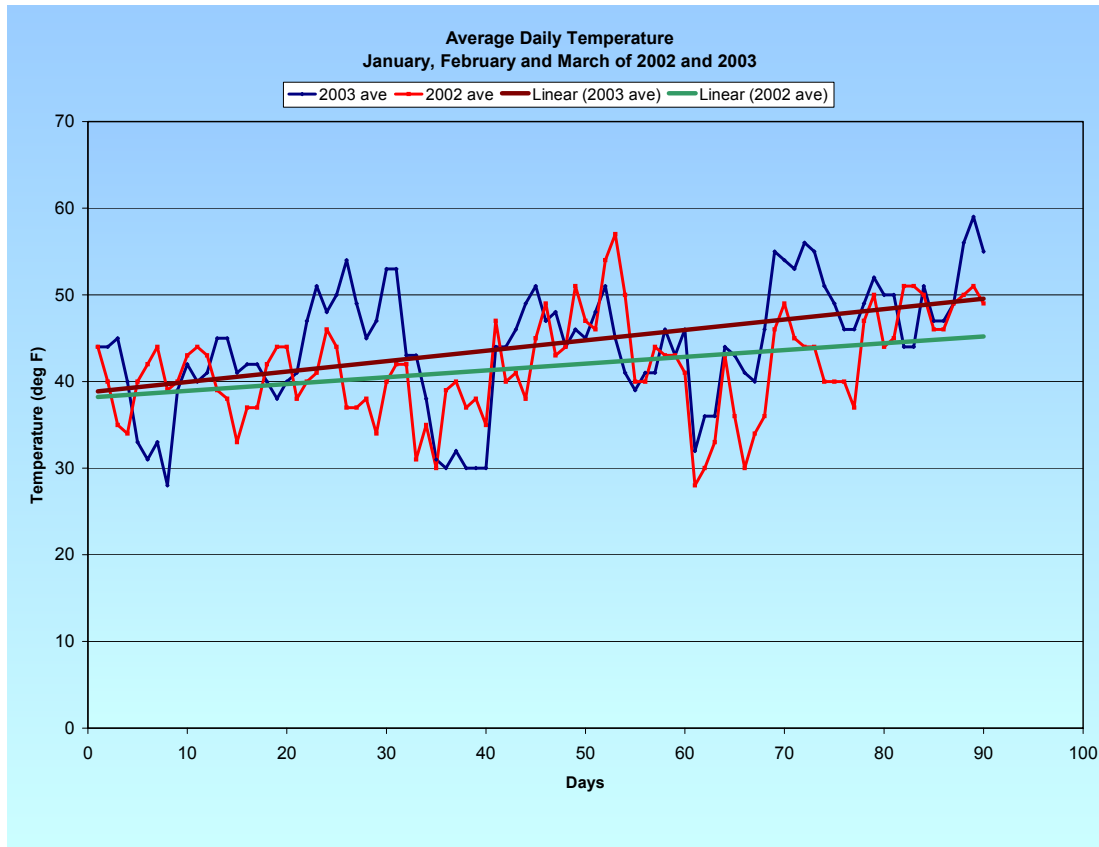


Figure 9. Daily Air Temperatures for January, February and March – Years 2002 and 2003

Storm Peak Intensity Attenuation (reduces runoff rates)

The following four figures show retention relative to specific storm events of varying intensities and times of year. Peak rainfall intensities for the storms shown on Figures 10-13 range from 0.041 to 0.193 cfs for rain run-on, whereas corresponding peak runoff flows range from 0.008 to 0.012 cfs. Even when the substrate is saturated, the ecoroof system attenuates the intense run-on peaks of even the largest winter storms. Notice how the runoff flows seem to stay relatively flat when the peaks occur. Figure 10 shows a very intense winter downpour, where the peak runoff is 1/16th the peak run-on. For a similar event Figure 11 shows that a very intense peak is almost totally attenuated by the ecoroof. Figure 12 shows a large storm, about equivalent to a 2-year/ 24-hour event typical of Portland in that it does not necessarily have an intense peak. Figure 13 shows a somewhat common winter storm after a series of preceding days with rainfall. Peak intensities for the Feb 2002 and Sept 2002 storms are much more intense.

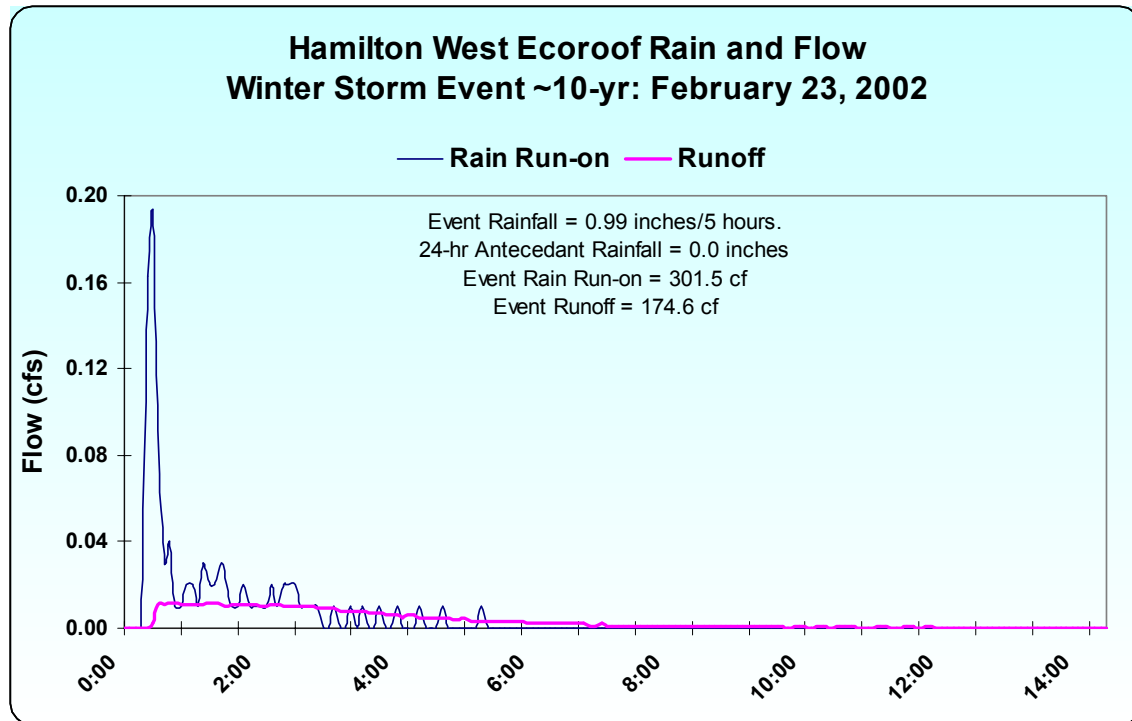


Figure 10. High Intensity, Short Duration Winter Storm.

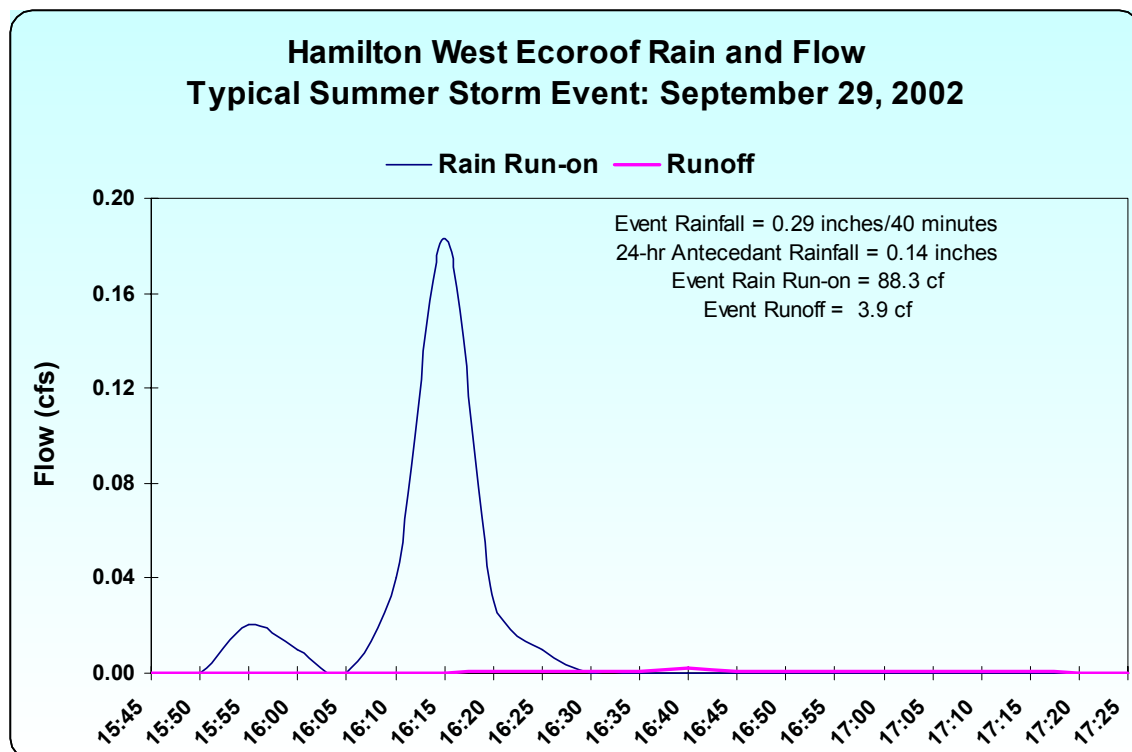


Figure 11. High Intensity, Short Duration Summer Storm

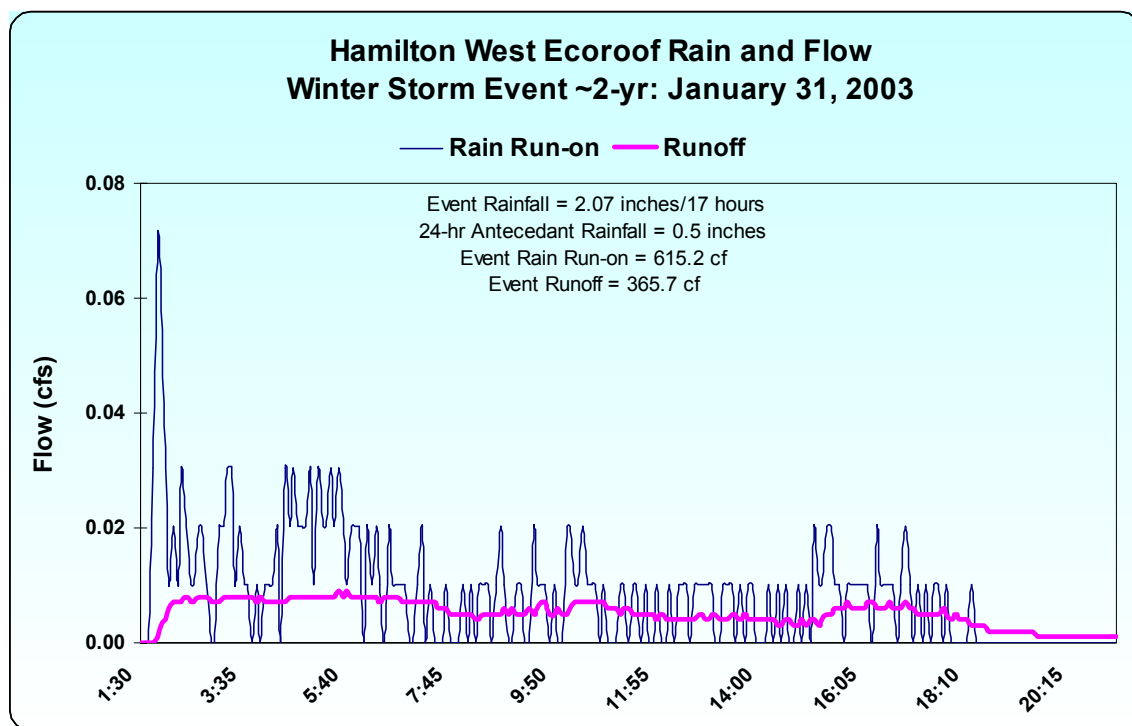


Figure 12. Low Intensity, High Volume Winter Storm

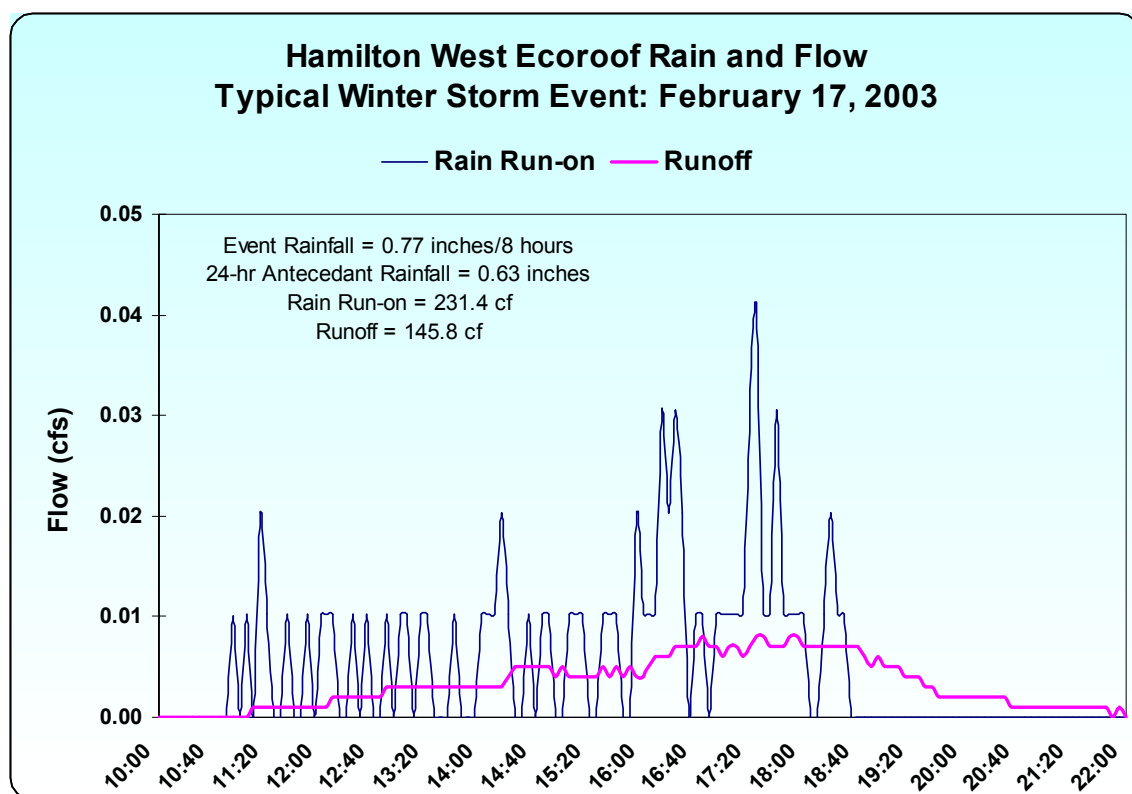


Figure 13. Low intensity, Low Volume Winter Storm

Stormwater Detention (slows the flow of runoff)

Another characteristic of the ecoroof performance is runoff detention. Aside from the fact that rainfall is retained in the ecoroof, its runoff rate is diminished compared to what conventional roof runoff would be. Due to the relative small size of these ecoroofs the time of concentration is almost instantaneous and thus a conventional roof would have almost immediate runoff. For a simple comparison, one could use the rain run-on line shown on any of the above Figures 10-13 as the conventional roof runoff rate. The runoff line then shows how significant the detention is for a vegetated roof as compared to a conventional roof. However, the runoff from an ecoroof may continue for many hours past the last recorded rain. The conventional roof runoff would stop within minutes of the last rainfall.

Water Quality

The city's initial primary interest in ecoroofs was related to flow attenuation. At the time the project started, there was no known information on water quality characteristics of ecoroof runoff. Water quality sampling was conducted to determine what effect the ecoroof substrate has on water quality. To date, eight storm events have been sampled with data available for the first seven (analyses currently underway on the last event). Figures 14-16 display data for three of the many parameters analyzed along with rainfall associated with each sampling event. Since runoff samples from a conventional roof were not collected, comparative conclusions cannot be drawn from this data.

Figures 14 and 15 show constituents such as total phosphorous (TP) and ortho-phosphorous at concentrations above Oregon receiving water standards. Note the difference between east and west ecoroof flow concentrations and the substrate chemical composition shown in Table 2. In Oregon, phosphorous concentrations are considered of most concern during the dryer months May-October. It appeared that over time phosphorus levels might be coming down, until the last 3 events as shown in Figures 14 and 15. However it appears from the data that warmer months such as April and May have the lowest concentrations. BES may attempt to gather additional warm weather data from these ecoroofs or may move to monitoring other ecoroof installations.

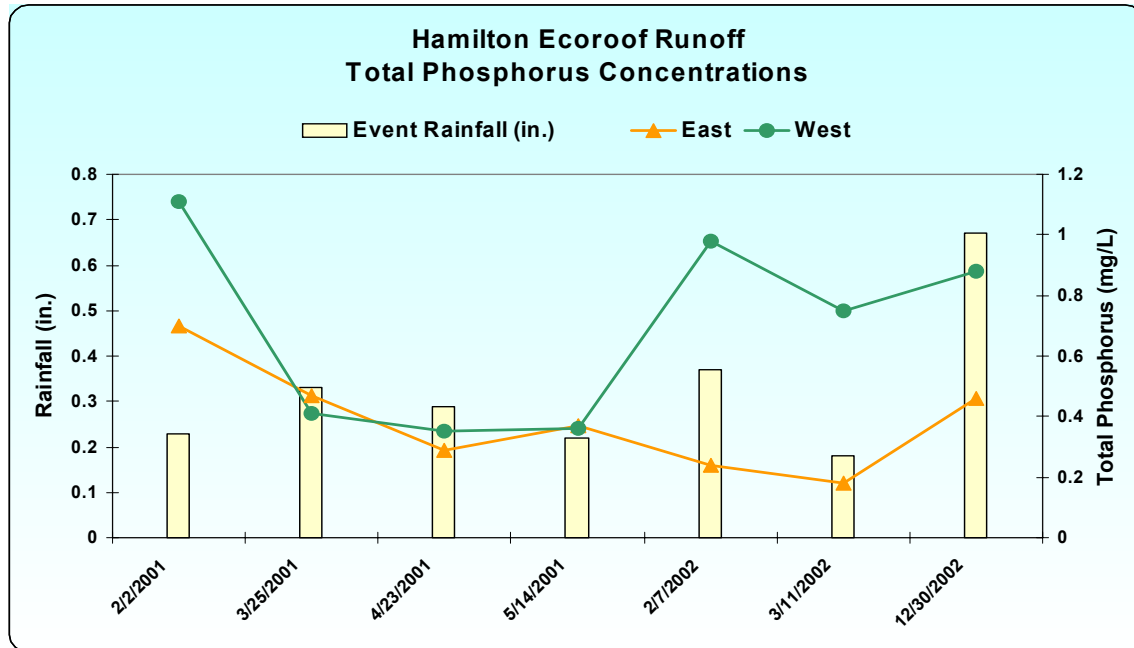


Figure 14. Total phosphorus concentrations in runoff from both the east and west ecoroofs.

Another important characteristic is the ecoroof affect on loadings. As shown above, many storm events, especially the warm season storms, significantly reduce flow volumes, thus reducing loadings. And in many cases the flow is zero with zero concentrations, particularly during the drier times of year.

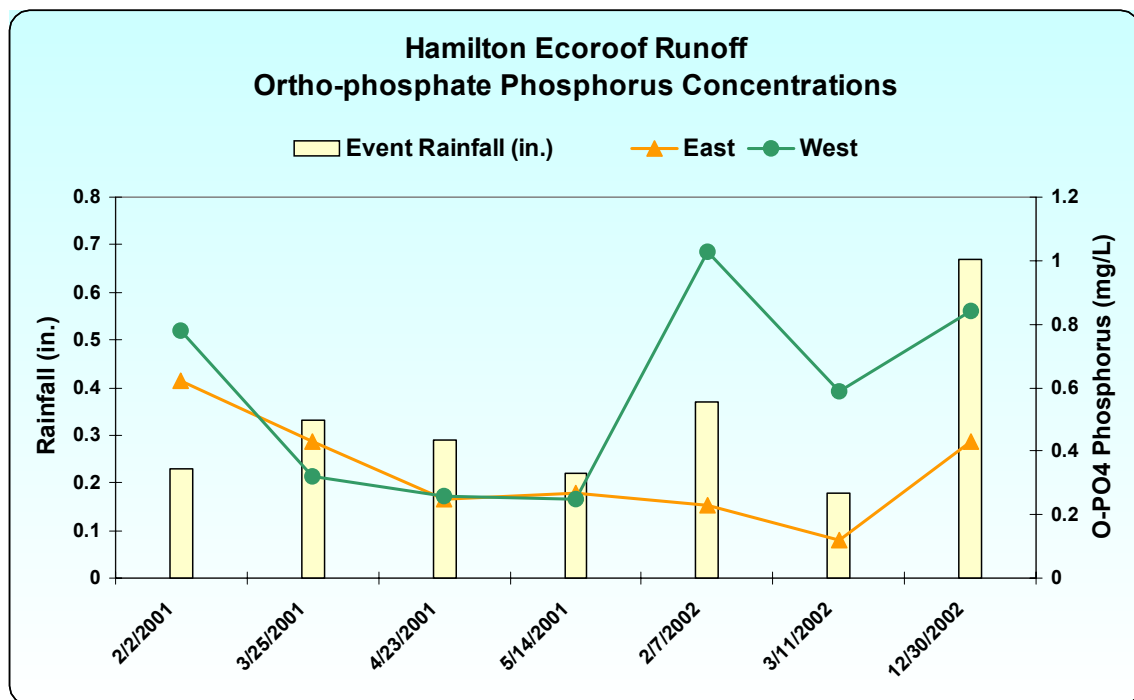


Figure 15. Orthophosphate concentrations in runoff from both the east and west ecoroofs.

Figure 16 shows dissolved copper concentrations which, based on water hardness, are usually below in-stream standards. However, 3 of the 14 samples were above the criteria, two in the warmer months and one in winter 2002. Numerous factors will be considered to determine the cause of these issues. But again, attention to substrate ingredients and materials to be used on the ecoroof can affect these parameters. For example, the roofing industry uses an abundance of galvanized metals, copper and lead. A potential source for copper on the Hamilton building could be the treated lumber the landscape contractor used for edging material. Background levels in the west ecoroof may be high due to the natural topsoil mixed with the substrate. However, as pointed out above, the copper loadings would be much reduced because the warm weather flows are almost zero. One option that should be evaluated in reducing pollution from all roofs is the types of roofing materials that are allowed. Several projects in Southern California (Crystal Cove, Newport Beach for example) have restrictions on copper and zinc containing materials being used for roofs, gutters, and downspouts.

Another issue related to ecoroof runoff quality is the contribution of certain constituents from the terrace area and building maintenance activities. Numerous rooftop activities can occur with lots of food, drinks, fireworks, dogs, wildlife, and many other pollutant sources. An important lesson to date is that these sources should be addressed in monitoring studies and education efforts.

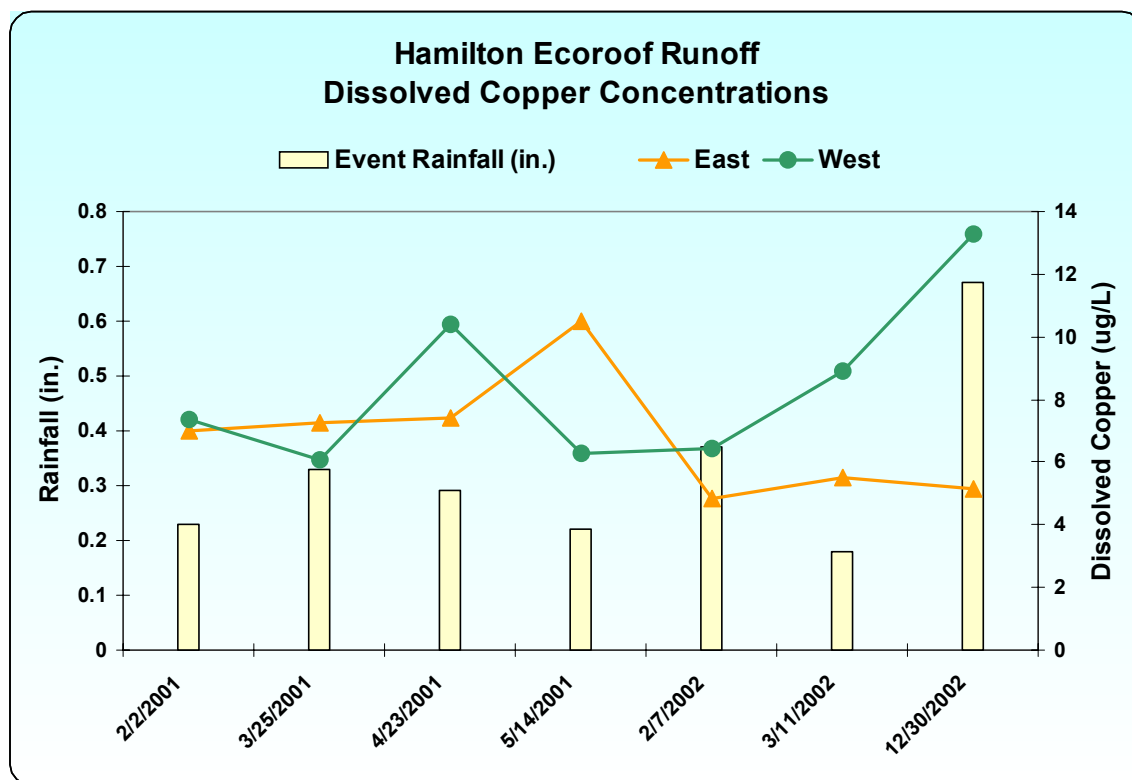


Figure 16. Dissolved copper concentrations measured in runoff from both the east and west ecoroofs. Most samples (11 of 14) were below acute water quality criteria of 0.9 ug/l at a hardness of 50 mg/l.

Summary

Precipitation that lands on an ecoroof acts in the following ways.

1. Portions of it are intercepted by vegetation and then evaporate;
2. Portions are absorbed in the substrate;
3. Portions in the substrate are taken into the vegetation and then transpire;
4. Some water evaporates from the substrate; and
5. Excess amounts flow through the substrate and become runoff.

These characteristics are highly affected by seasonal conditions. Interception, evaporation, and transpiration act to prevent runoff. This portion of the rain never turns into runoff. One of the primary objectives of the monitoring program has been to assess the effectiveness of ecoroofs in reducing the volume of runoff.

After two years of trials, BES has amassed data that is beginning to show that ecoroofs, such as the Hamilton project, provide significant stormwater management benefits. Our data reveals that a 25-psf ecoroof, measuring 4-5 inches thick, can absorb approximately 69% of rainfall falling onto it. We have also seen 100% retention for most warm weather storms. Detention rates are much higher than traditional roofs for a range of storms from small to at least the 2-year event measured. These results are for an ecoroof with only 72% vegetative coverage.

These monitoring results will be used by BES to model infrastructure benefits, such as reducing impacts to the aging portions of the sewer systems, prevent basement flooding, and reduce erosive flows to streams and creeks.

In addition, it appears that water quality could be significantly improved via loadings (volume) reduction as well as pollutant removal/avoidance. Additional monitoring data on ecoroof water quality will be conducted to assess the benefits of concentration reductions, and the loading reductions from reducing runoff amounts. There is a need to be strategic about the selection of soils/growing media to use on ecoroofs as some soils may contain higher levels of pollutants. In addition other roof materials, such as treated woods need to be avoided.

Developers in Portland are gaining confidence in the value of ecoroofs, as more and more builders gain experience with ecoroof design and construction. The City allows developers to meet or partially meet their stormwater treatment requirements with an ecoroof. In dense urban situations, this has become more and more attractive to developers. In addition, the City allows larger buildings as an incentive. In the future, there will be a potential reduction in stormwater fees via a reduced fee for those sites with ecoroofs. One of the primary reasons that developers are embracing the program is the City's technical and permitting assistance provided by the Bureau of Environmental Services.

As with any stormwater management measure, good design and maintenance are keys to their success. It is expected that, due to virtual elimination of sun energy on roof surfaces and resulting degradation of roof materials, ecoroofs will likely be found to last much longer than many traditional roof materials. As with any roof, good construction techniques are important. The City is undertaking economic analyses of life cycle costs, and research on the multiple benefits of ecoroofs, to further demonstrate their value and effectiveness to developers and the community at large.

References

Strecker, E. and Liptan T., Ecoroofs (Greenroofs) – A More Sustainable Infrastructure: National Conference on Urban Stormwater: Enhancing Programs at the Local Level. February, 2003.

Fischer, P. and Jauch, M., Dranwasser in Trinkwasserqualität?; Dach Grün, Fachmagazin für Bauwerksbegrünung, Dezember 2002.

City of Portland, Bureau of Environmental Services Hydra–Data System, 1997-2003.

ECOROOF

Q & A uestions answers

Portland's Ecoroof Program is a cooperative effort of the Bureau of Environmental Services and the Office of Sustainable Development. The program promotes ecoroofs by researching ecoroof technologies and providing information and technical assistance to community members.

WHAT IS AN ECOROOF?

An ecoroof is a lightweight, low-maintenance vegetated roof system used in place of a conventional roof. The City of Portland is encouraging the use of ecoroofs as part of its efforts to promote sustainable development. This means using practices that respect natural systems and limit impacts on the environment. Sustainable development practices promote environmental, economic, and social health today, while also protecting and sustaining the well-being of future generations.

Ecoroof opportunities come in all sizes:

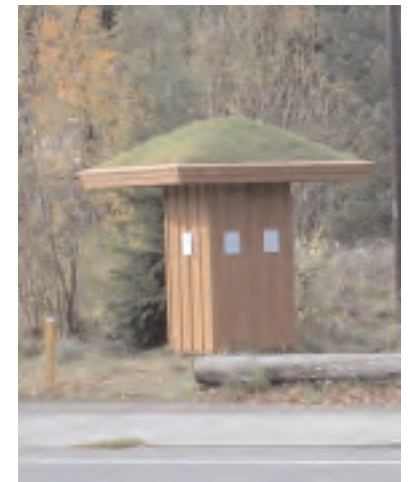
Large commercial buildings, residential homes and garages, or as small as a toolshed or kiosk.



Hamilton West Apartments



residential garage



park natural area tool shed

❶ What are the benefits of Ecoroofs ?

Based on documented experience and studies, an ecoroof offers several important benefits not found in conventional roofing:

- Captures and evaporates from 10 to 100 percent of the precipitation that falls on it. This reduces the volume and speed of stormwater runoff leaving the site, helping prevent sewer overflows and protect rivers and streams.
- Lowers the temperature of stormwater runoff, which helps maintain the cool stream temperatures needed by fish.
- Improves outdoor air quality by decreasing air temperatures and reducing smog.
- Increases vegetation and wildlife habitat on urban sites that typically have neither.
- Provides insulation and lowers cooling costs for the building.
- Provides an attractive alternative to a conventional roof.
- Lasts twice as long as a conventional roof, saving replacement costs and materials
- Creates a market for recycled materials, such as compost, mulch, soil and other ecoroof components.
- Creates jobs in multiple industries.
- Is an approved stormwater management technique under Portland's Stormwater Management Manual requirements for new development and redevelopment.
- Can earn floor area bonuses for proposed buildings in Portland's Central City Plan District. Increasing the building space that would otherwise be allowed.



Multnomah County Building



Buckman Terrace Apartments

Ecoroofs are a proven technology and have been used in Europe for over 40 years. They are now gaining recognition in the US for the environmental, economic, and social benefits they provide.

② Where can an Ecoroof be used ?

- Ecoroofs can be located on flat or pitched roof structures at a slope up to 40 percent (or 5 in 12 pitch). They can be used on most types of commercial, multifamily, and industrial structures, as well as single-family homes and garages.
- Ecoroofs can be used for new construction or to re-roof an existing building.



People's Food Co-op

③ What does an Ecoroof cost ?

It is important to note that there is a wide range of costs, depending on many factors. Installation of an ecoroof costs from \$10 to \$25 per square foot (sf). This includes materials, labor, and structural upgrades. A conventional roof installation ranges from \$3 to \$20 per sf. As the ecoroof market develops, costs may decrease.

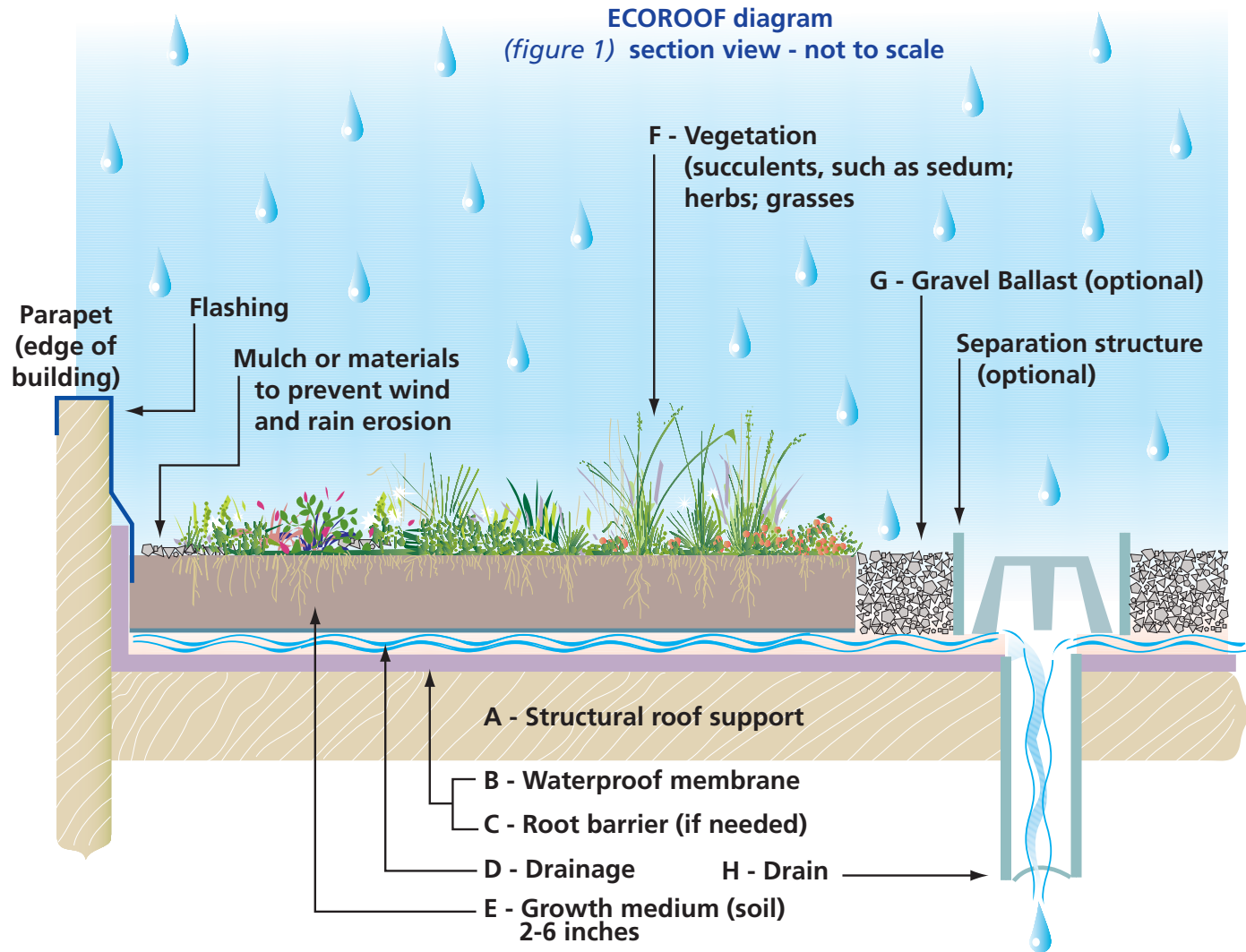
	Ecoroof (cost per square foot)	Conventional Roof (cost per square foot)
New construction (including structural support)	\$10 to \$15	\$3 to \$9
Re-roofing	\$15 to \$25	\$5 to \$20

Source: Bureau of Environmental Services estimates based on City of Portland demonstration projects, and information obtained from roof contractors.

Although ecoroofs initially cost more than conventional roofs, they are competitive on a life-cycle basis because of reduced maintenance and replacement costs (see question #5).

④ What Are the Components of an Ecoroof ?

Ecoroof configurations vary, but typically include the elements shown in the diagram and described on pages 4-8.



A - STRUCTURAL ROOF SUPPORT

For Re-Roofing

The structural roof support must be sufficient to hold the additional weight of the ecoroof. Check with an architect, structural engineer, or roof consultant to determine the condition of the existing building structure and what might be needed to support an ecoroof. This might include additional decking, roof trusses, joists, columns, and/or foundations.

Generally, the building structure must be adequate to hold an additional 10 to 25 pounds per square foot (psf) saturated weight, depending on the vegetation and growth medium that will be used. (This is in addition to snow load requirements.) An existing rock ballast roof may be structurally sufficient to hold a 10-12 psf ecoroof. (Ballast typically weighs 10-12 psf.)

For New Construction

The project architects and structural engineers can address the structural requirements of an ecoroof during the design process. Greater flexibility and options are available for new buildings than for re-roofing.

The procedures for the remaining components (B through I) are the same for both re-roofing and new construction.

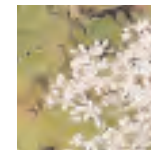
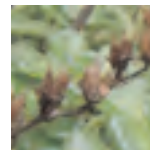
B - WATERPROOF MEMBRANE (IMPERMEABLE LINER)

Waterproof membranes are made of various materials, such as modified asphalts (bitumens), synthetic rubber (EPDM), hypolan (CPSE), and reinforced PVC. Some of the materials come in sheets or rolls and some are in liquid form. They have different strengths and functional characteristics. Many of these products require root inhibitors (refer to C) and other materials to protect the membrane. Numerous companies manufacture waterproofing materials appropriate for ecoroofs.

C - ROOT BARRIER (IF NEEDED)

Root barriers are made of dense materials that inhibit root penetration.

The need for a root barrier depends on the waterproof membrane selected. Modified asphalts usually require a root barrier, while synthetic rubber (EPDM) and reinforced PVC generally do not. Check with the manufacturer to determine if a root barrier is required for a particular product.



D - DRAINAGE LAYER (IF NEEDED)

There are numerous ways to provide drainage. Products range from manufactured perforated plastic sheets to a thin layer of gravel. Some ecoroof designs do not require any drainage layer other than the growth medium itself, depending on roof slope and size (for example, pitched roofs and small flat roofs).

E - GROWTH MEDIUM (SOIL)

The growth medium is generally 2 to 6 inches thick and well drained. It weighs from 10 to 25 pounds per square foot when saturated. A simple mix of topsoil, compost, and perlite may be sufficient for many applications. Some companies have their own growth medium specifications. Other components could include:

- Digested fiber
- Expanded clay or shale
- Pumice
- Coir

These soils are prone to wind erosion when exposed. It is important to ensure good plant coverage and/or mulch.

Ecoroofs are an evolving industry, with new materials and approaches continually being developed. In Europe, for example, recycled clay roof tile is being used as a growing medium and a modular design has recently been developed by a US firm.



spring blooms

late summer color



New modular units with soil and vegetation have been developed and are now available.

F - VEGETATION

Ecoroof vegetation should have the following attributes:

- Drought-tolerant, requiring little or no irrigation after establishment
- A growth pattern that allows the plant to thoroughly cover the soil
- Self-sustaining, without the need for fertilizers, pesticides, or herbicides
- Able to withstand heat, cold, and high winds
- Very low-maintenance, needing little or no mowing or trimming
- Perennial or self-sowing
- Fire resistant

A mix of sedum/succulent plant communities is recommended because they possess many of these attributes. Herbs, forbs, grasses, and other low groundcovers can also be used to provide additional benefits and aesthetics; however, these plants may need more watering and maintenance to survive and keep their appearance.



Installation

Four methods (or combinations of them) are generally used to install the vegetation: vegetation mats, plugs/potted plants, sprigs, and seeds.

- 1 **Vegetation mats** are sod-like, pre-germinated mats that achieve immediate full plant coverage. They provide immediate erosion control, do not need mulch, and minimize weed intrusion. They also need minimal maintenance during the establishment period and little ongoing watering and weeding.
- 2 **Plugs or potted plants** may provide more design flexibility than mats. However, they take longer to achieve full coverage, are more prone to erosion, need more watering during establishment, require mulching and more weeding.
- 3 **Sprigs** are hand broadcast. They require more weeding, erosion control, and watering than mats.
- 4 **Seeds** can be either hand broadcast or hydraseeded. Like sprigs, they require more weeding, erosion control, and watering than mats.

For plugs, sprigs, and seeds, it is extremely important to protect the growth medium from erosion (e.g., using mulch, netting, or gravel) until it is fully covered by vegetation.

G - GRAVEL BALLAST (IF NEEDED)

Gravel ballast is sometimes placed along the perimeter of the roof and at air vents or other vertical elements. The need for ballast depends on operational and structural design issues. It is sometimes used to provide maintenance access, especially to vertical elements requiring periodic maintenance. In many cases, very little, if any, ballast is needed.

- In some situations, a header or separation board may be placed between the gravel ballast and adjacent elements (such as soil or drains).
- If a root barrier (C) is used, it must extend under the gravel ballast and growth medium, and up the side of the vertical elements.

H - DRAIN

As with a conventional roof, an ecoroof must safely drain runoff from the roof. It may be desirable to drain the runoff to a rainwater harvesting system such as (rainbarrels or cisterns), or other stormwater facilities such as planters and swales.



I - IRRIGATION

Irrigation is likely to be needed during the establishment period and possibly during drought conditions, regardless of the planting method used. This can be accomplished either through hand watering, a manually operated low-tech irrigation system (such as spray heads or soaker hoses), or an automated irrigation system. To minimize water needs, early autumn is the best planting season. The goal is to minimize the need for irrigation by paying close attention to plant selection, soil and various roof characteristics.



The typical
lifespan
for an
ecorooft is
about
40 years.

⑤ What Are the Operations, Maintenance, and Replacement Needs?

Similar to conventional roofs, ecoroofs require some degree of care to maintain optimum function.

VEGETATION/GROWTH MEDIUM

Periodic inspection (at least twice a year) is needed for any type of roof to ensure drain inlets are not blocked. For ecoroofs it is also important to check the health and coverage of the vegetation; some replacement or filling may periodically be needed. Depending on the design, some plants may “brown out” or almost disappear from sight; however, they are still viable and will revive in the rainy season.

Depending on the planting method, weeding and mulching may be needed during the establishment period and periodically thereafter over the life of the ecorooft.

FIRE SAFETY

Sedum and other succulents are naturally fire resistant, almost eliminating fire concerns. Other types of vegetation could be of concern and need to be watered, mowed, and/or maintained to prevent fire. Depending on the seasonal rains in Portland, it is best to mow a dry grass roof before July 4th.

ACCESS

Most buildings require roof access for operations and maintenance. Access is needed for mechanical units, window washing, elevator repair and other activities. These should be identified during the design phase,

and access paths of gravel or other inert materials provided. In cases where access is needed only occasionally, paths may not be required because the vegetation can tolerate some foot traffic.

LEAKAGE

An ecorooft is considered less likely to leak than a conventional roof. If a leak does occur, it has been speculated that it may be more difficult to pin point the leak on an ecorooft than a traditional roof. However, because ecoroofs are thin, they can be removed and replaced in mats or sections.

REPLACEMENT

According to various sources the typical lifespan for an ecorooft is about 40 years, significantly longer than a conventional roof. This is because the membranes are of good quality and the plants and growth medium protect the membrane from weathering. Replacing an ecorooft involves:

- Removing and stockpiling the vegetation, growth medium, irrigation pipes, and drainage layers. (It may be possible to simply move these materials to one side, rather than removing them entirely.)
- Removing and replacing the waterproof membrane.
- Reinstalling the stockpiled growth medium, vegetation, and other components.

⑥ Where Can You See Examples of Ecoroofs?

There are ecoroofs throughout the City. Below are a few of the ecoroofs you can see in Portland.

Property:	To arrange a tour, contact:
<ul style="list-style-type: none"> Hamilton West Apartments Building (SW 12th and Clay) 	Ecoroof Program (Environmental Services) 503-823-7267 or 503-823-7740
<ul style="list-style-type: none"> Buckman Terrace Apartments (NE 16th and Sandy) 	Ecoroof Program (Environmental Services) 503-823-7267 or 503-823-7740
<ul style="list-style-type: none"> Jean Vollum Natural Capital Center (NW 10th and Flanders) 	Ecotrust: 503-227-6225
<ul style="list-style-type: none"> Native American Student and Community Center- 710 SW Jackson street 	Access during business hours Portland State University
<ul style="list-style-type: none"> Columbia Boulevard Treatment Plant 	Main Desk: 503-823-2400
<ul style="list-style-type: none"> Multnomah County Building 501 SE Hawthorne Blvd 	Open to public 8:30 am - 5:00 pm Check with security on the main floor.
<ul style="list-style-type: none"> B&O Building SE Washington Street and 2nd Avenue 	Pat Lando - 503-233-6600
<ul style="list-style-type: none"> Hawthorne Hostle 3031 SE Hawthorne Blvd 	Viewable from sidewalk
<ul style="list-style-type: none"> People's Food Co-op 3039 SE 21st Avenue 	Viewable from sidewalk

For information on a self-guided tour see the
Portland Ecoroof Tours (pdf) booklet online at
www.portlandonline.com/shared/cfm/image.cfm?id=45940



Ecotrust Building

⑦ What Permits Are Needed?

For Re-Roofing

- A building may need upgraded structural support for an ecoroof, although many existing buildings are structurally sound enough. In either case, a signed document from a structural engineer is required in order to receive a building permit from Portland's Office of Planning and Development Review (OPDR).
- An ecoroof may require alteration of downspouts or other piping, requiring a plumbing permit from OPDR.

For New Construction

- For new development and redevelopment projects, an ecoroof permit is obtained through the standard application process.
- The ecoroof and other stormwater management elements must be reviewed by the Bureau of Environmental Services to verify the ecoroof is constructed to meet the City's Stormwater Management Manual requirements or for Floor Area Bonus approval.

⑧ Where Can You Get More Information and Assistance?

- Ecoroof Program (Bureau of Environmental Services): 503-823-7267 or 503-823-7740
- Stormwater design techniques (Bureau of Environmental Services): call 503-823-7740 or <http://www.cleanrivers-pdx.org>

- Green building approaches (Office of Sustainable Development): call 503-823-7222 or <http://www.sustainableportland.org>
- Building code and permitting information (Office of Planning and Development Review): <http://www.opdr.ci.portland.or.us> or call 503-823-7310 (for building code information) or 503-823-PLAN (for zoning information)

DESIGN AND INSTALLATION ASSISTANCE

Some vendors, design consultants, and installation contractors known to the City at the time of this printing are listed here. These providers offer a variety of services. Some may be limited to providing information about their specific products (such as impermeable liners), while others may be able to manage the entire project, including design, specifications, arranging for installation, and plant procurement.



Clean Water Services-Field Operations - Beaverton

ECOROOOF CONTACTS

This is a list of contacts, with experience in design and construction of ecoroofs. This list is for informational purposes only and does not constitute a recommendation by BES or the City of Portland. If you would like to be on this list please submit your contact information and specific information about your involvement with ecoroofs.

VENDORS MANUFACTURER REPS

American Hydrotech Inc.

Seattle: 206-441-6125
Illinois: 800-877-6125
www.hydrotechusa.com

Bain Associates Inc.

Portland: 503-452-0788
Jbherman@aol.com

Garland Company Inc.

Portland: 800-762-8225 ext. 655
Mobile: 503-860-4420
Seattle: 800-762-8225 ext. 515
www.garlandco.com

Green Grid

Chicago, Il: 312-424-3319
Greengridroofs.com

Green Tech

888-323-4397

W.P. Hickman

503-231-0280
206-841-7663

Sarnafil SA

Mass: 800-451-2505 ext. 257
www.sarnafilus.com/GreenRoofs.htm

Soprema Inc.

503-524-3382
800-356-3521
www.sopremaworld.com

Tremco Incorporated

Portland OR: 503-234-6407
Ohio: 800-321-7906
www.tremcosealants.com



Native American Student and Community Center-PSU

CONTRACTORS

Anderson Roofing Co., Inc.
503-294-0202, Doug Christie
anderson.roofing@comcast.net

All About Roofs
503-538-5066

Green Seasons Turf and Tree Inc.
503-263-4567

Northwest Raingardens
877-887-1149

Oregon Landscape Contractors Association
503-253-9091
www.oregonlandscape.org

Teufel Landscape
503-646-1111

CONSULTANTS

AEI
Portland: 503-452-8003
www.alpha-eng.com

Greenroof Design Consultant
770-674-4624
www.Greenroofs.com

Green Roofing Consultant
Quebec, CAN 418-682-2478
Ma_boivin@videotron.ca

Greenworks
Portland: 503-222-5612
Mf@greenworkspc.com

HOK Architects
Washington D.C.: 202-339-8728
www.thehokplanninggroup.com

Katrin Scholz-Barth Consulting
Washington D.C.: 202-544-8453
Katrin@Scolz-Barth.com

Lango Hanson
Portland: 503-295-2437
Kurt@LangoHanson.com

Macdonald Environmental Planning, PC
Portland: 503-224-1225
www.mep-pc.com

Murase Associates
Portland: 503-242-1477

North American Wetland Engineering
Forest Lake, MN: 651-433-2115
Nawe@visi.com

PIVOT design & consulting LLC
Portland: 503-235-5429
eshriner@mindspring.com

Rana Creek Habitat Restoration
Carmel Valley, CA: 831-659-3811
Ranacreek@earthlink.net
Ranacreek.com

Roofscapes Inc.
Philadelphia, PA: 215-247-8784
www.roofmeadow.com

Schaber and Associates, Inc
503-655-8921
Kschaber@rci-online.org
www.Rci-online.org

Soderstrom Architechs, P.C.
503-228-5617
www.sdra.com

Lando & Associates, Landscape Architects
Portland: 503-233-6600
www.lando-landscapearchitecture.com

NURSERIES - SOIL PROVIDERS
Oregon Association of Nurserymen
503-653-8733
www.oan.org

Pro-Gro
Sherwood: 800-682-3501
www.pro-gromixes.com

Squaw Mountain Gardens
Estacada, OR
503-630-5458
hennchicks@aol.com

ADDITIONAL WEB SITES
www.Greenroofs.com
www.Enn.com
www.Greenroofs.ca
www.ecoroofofseverywhere.org



ENVIRONMENTAL SERVICES
CITY OF PORTLAND

working for clean rivers

Dean Marriott, Director
Sam Adams, Commissioner

ECOROOFS
Questions & Answers
is available online
www.cleanrivers-pdx.org

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503-823-7740

PL 0452 revised Sept 2005

Frequently Asked Questions about Low Impact Development (LID)

1. What is LID?

LID is defined by the *LID Technical Guidance Manual for Puget Sound* (January 2005) as a stormwater management and land development strategy applied at the parcel and subdivision scale that emphasizes conservation and use of existing natural site features integrated with distributed small-scale stormwater controls to more closely mimic natural hydrologic patterns in residential, commercial, and industrial settings.

The LID approach to developing land and managing stormwater is to imitate as much as possible the natural, pre-development hydrology (or movement of water) of the site. In a mature Pacific Northwest forest, for example, almost all the rainfall (or snowmelt) disperses along the forest floor, where it infiltrates into the ground, is taken up by the roots of plants and trees, or evaporates. Researchers estimate that less than one percent becomes surface runoff. But when forests and natural open spaces are cleared, and buildings, roads, parking areas and lawns dominate the landscape, rainfall becomes stormwater runoff, carrying pollutants to nearby waters. Much less water infiltrates and is taken up by plants, less evaporates back to the atmosphere, and much more (about 20-30 percent in a suburban neighborhood) becomes surface runoff or stormwater runoff.

2. What are the benefits of LID?

When combined with other key elements of a comprehensive local stormwater program, effective land-use planning under the Growth Management Act and watershed or basin planning, LID can help communities more efficiently and effectively manage stormwater and protect their water resources.

- **LID can help better protect the environment.** LID techniques remove pollutants from stormwater, reduce the overall volume of stormwater, manage high storm flows, and recharge—or replenish—streams and wetlands.
- **LID can help reduce flooding and protect property.** Reducing impervious surfaces, increasing vegetation and dispersing and infiltrating stormwater results in less runoff. This reduces the likelihood of flooding from big storms.

- **LID helps protect human health** by more effectively removing pollutants from stormwater. Untreated stormwater can be unsafe for people to drink or swim in.
- **LID protects drinking water supplies** by ensuring that rainfall infiltrates where it can recharge aquifers, rather than being treated as a waste and discharged to marine waters.
- **LID is good for the economy.** LID can help protect shellfish growing businesses, water quality and marine sediment quality. This ensures that our resources remain clean and Puget Sound remains a great place to run a **business and attract employees. Taxpayers don't have to pay for expensive** cleanup efforts for polluted waters and sediments. And because LID projects in many cases are less expensive to build, it means that developers and builders can often save money on overall development costs by using LID.
- **LID provides cost-effective alternatives to systems upgrades.** Land developed prior to the 1990s usually provides little, if any, stormwater treatment. In many cases, LID systems, such as bioretention, are much less expensive to use than costly stormwater vaults or land-consuming stormwater ponds.
- **LID can increase the appearance and aesthetics of communities.** LID projects leave more trees and plants and have less impervious surfaces, which makes for greener developments and communities.
- **LID can increase public safety.** One of the hallmarks of LID is narrower streets. Studies show that when vehicle traffic is slowed, there are fewer pedestrian accidents and fatalities.

3. What are some common LID Best Management Practices (BMPs)?

- Bioretention cells or swales (also known as rain gardens)
- Pervious pavement
- Preservation of native vegetation (also known as native vegetation areas)
- Amending soil with compost
- Vegetated roofs (also known as green roofs or eco-roofs)
- Minimal excavation foundations
- Rooftop rainwater harvesting
- Dispersion of stormwater into native vegetation areas

4. Where can LID be used?

Almost anywhere. LID BMPs can be used on land already developed or in new development projects. They can be used along residential and inner city streets, and along state highways. They can be used in parking lots of businesses and industries, and in residential driveways. They can be used at single-family residences and multi-family projects, in very dense urban settings and in more rural areas. They can be used as part of planned unit developments and other planned developments.

5. Do you have to use all of the LID BMPs in order for a project to be considered LID?

Using LID BMPs on any development site certainly helps. Yet if a local government is going to offer incentives to encourage LID (for example, public recognition, **streamlined permitting, or a density bonus**), they usually want to make sure there's a commensurate benefit to their community. They want to make sure the project is truly an LID project, and not one that just uses one or two LID BMPs to manage a small portion of the stormwater.

AHBL worked with staff from the Puget Sound Partnership, WSU Extension, and the Department of Ecology to come up with some minimum criteria for defining a project as LID. These criteria are outlined in the draft LID Chapter prepared under the LID Local Regulation Assistance Projects in 2005, 2006, 2008, and 2009 and include minimum amount of stormwater managed by LID BMPs (based on soils and density), minimum percentage of native vegetation retained on site, and maximum allowable impervious surface.

6. Can you use LID BMPs on sites with till soils?

Yes. The practicality and viability of implementing LID is dependent on a number of factors, including the type of soils on site and their infiltration rates. Some soils, such as those with high clay content make infiltration difficult and in some cases impractical. Nevertheless, even soils with low infiltration capacities (e.g. infiltration rates below 0.30 inches per hour) can still be viable candidates for LID, depending on the site conditions and goals of the LID facility. For example, stormwater can still be dispersed into native vegetation with slow infiltrating soils. And bioretention swales can be designed to hold rainwater until it can slowly infiltrate. A careful site assessment should be conducted to understand the practicality of LID on a site, and LID BMPs should always be designed based on the capacity of the soils on site and according to guidance outlined in the *LID Technical Guidance Manual for Puget Sound* (current edition).

7. What are examples of incentives that other jurisdictions are using to promote LID?

- Flexibility in Bulk, Dimensional & Height Restrictions
- Density Bonus
- Dedicated Review Team
- Reduced Review Time/ Expedited Review
- Lower Stormwater System Development Fees
- Reduced Application Fees
- Revised Fee Structure
- Public Recognition
- Adjustments to the Required Parking
- Property Tax Reduction

8. Have any jurisdictions made LID mandatory? If so, which ones?

(Note: *Jurisdictions listed are those that have participated in the LID Technical Assistance Projects*)

- Mason County in the Belfair and Allen Urban Growth Areas (2006 participant)
- San Juan County (2008 participant) – recommendations not yet adopted but took a prescriptive approach
- Town of Hamilton (2008 participant) – recommendations not yet adopted but took a prescriptive approach
- City of Lake Forest Park (2008 participant)
- City of Kent (2009 participant) – recommendations delivered June 2009; took a prescriptive approach
- Island County (2009 participant) – recommendations delivered June 2009; took a prescriptive approach
- City of Sequim (2009 participant) – recommendations delivered June 2009; took a prescriptive approach

9. What are some good resources for LID?

- **Puget Sound Partnership's LID web site:**
http://www.psparchives.com/our_work/stormwater/lid.htmLID Technical Guidance Manual for Puget Sound: <http://www.psp.wa.gov/documents.php>
- **U.S. EPA's LID web site:** <http://www.epa.gov/owow/nps/lid/>
- **LID Center, Maryland:** <http://www.lowimpactdevelopment.org/>
- **Seattle's Natural Drainage Systems:**
http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Natural_Drainage_Overview/index.asp

Grasspave2
Maintenance Guide
for
Owners and Maintenance Staff

by

Invisible
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Grasspave² - Maintenance Guide

Regular maintenance is required to maximize traffic on grass paved areas with minimum wear and tear problems. The following maintenance and repair information, compiled from more than a decade of client experience with Grassrings and Grasspave², will enable staff to keep your grass paved areas healthy and beautiful all year long.

For more information about basic maintenance, or for answers to questions about a unique site, call Invisible Structures, Inc., toll free, at 1-800-233-1510.

Normal Maintenance

Grasspave² paved areas require basically the same care as other turf areas. Mow, irrigate, and fertilize as necessary for selected grass species for a healthy turf. As levels and frequency of traffic increase, greater stress is placed on the turf, which requires careful observation and response by maintenance staff. Recommended fertilizers and micronutrients:

- **N,P,K Fertilizers** - for other fertilizer applications, use fertilizers best for grass species used. As traffic frequency increases, the need for additional nitrogen increase in order to make the grass GROW faster and replace damaged blades quickly. Take care to use fertilizers that do not have poor materials such as clay as "fillers." The best fertilizers are:

- slow release (temperature activated)
- liquid concentrates (through irrigation system)

- **Micronutrients** - apply fertilizer supplemented with micronutrients, such as Humate, once a year. Or, apply the micronutrient in a separate application.
- **Other Chemicals** - apply water, herbicide, and insecticides as needed in response to site specific needs/problems.

Aeration

IMPORTANT!! DO NOT AERATE

GRASSPAVE² INSTALLATIONS!

Aeration is a treatment for compaction problems, associated with poor percolation.

Grasspave² paved areas do not need aeration because, if properly installed, compaction will not occur. Aeration equipment will damage the Grasspave² structure and could prevent its long term function.

If compaction and poor water penetration problems arise, they can be due to filling rings with organic soils. (Many sod farms grow sod in high organic soils, such as peat.) When these soils dry out, there can be severe shrinking. The use of dry fertilizers with clay as a "filler" material (sometimes as much as 70% of the bag contents) can also contribute to compaction and poor water penetration. Organics (silt, clay, peat) can effectively seal off the surface of the grass paved areas, preventing entry of air and water to the roots.

Poor percolation can also be a result of chemical change to soils of ionic charges that might increase water repellency of soils. Solutions include treatment with products or chemicals such as wetting agents (diluted detergents), gypsum, etc. Your local County Extension agent can be an excellent source for advice on local conditions.

Antifreeze Spills - See Oil/Antifreeze Spills

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Bare Spots - Causes and Solutions

It is important to determine the cause of bare spots in order to select the most appropriate solution. Some possible causes and solutions:

(Cause / Solution)

- *Incorrect sod (sod grown in peat, silt, or clay) for high traffic areas*

Totally replace with sand grown sod and rings, for low traffic areas; amend soil with chemicals such as detergents and gypsum and add sand to cracks for low traffic areas, and reseed as needed.

- *Poor quality seed*
Reseed with fresh source.
- *Erosion*
Intercept source of water and redirect to reduce impact.
- *Lack of nutrient*
Increase water and fertilizer.
- *Shade*
Reduce shade cover or change grass to more shade tolerant species.
- *High traffic*
Increase fertilization and water, and / or reduce traffic frequency by limiting or alternating zones of access.

Bare Spots--Repair

1. Fill rings uniformly with clean sand (concrete sand is preferable) to the top of all rings. When seeding, lightly rake to disturb and loosen surface.
2. Moisten area with a diluted detergent solution to break the soil's surface tension.
3. Topdress small bare areas with a mixture of sand and grass seed that either matches the installed grass species or changes the species for an environmental response (such as a shade mix).
4. Mulch with a layer of cellulose (paper)

placed over the topdressing mix to speed germination and prevent surface erosion by irrigation or rainfall. Commercial mulch materials should have a fine texture, such as those used for hydromulching. If visually acceptable, thin strips of newspaper (per office shredders) can be used very effectively as mulch.

5. Inject Hydrogrow. Hydrogrow's advantage is that it is able to store moisture and dissolved nutrients within the root zone, making them directly available to plant roots. Check local dealers or equipment rental sources for machines (such as Olathe) to inject dry polymers by compressed air into existing installations.

Irrigation

Regular irrigation is necessary for grass subjected to the stress of daily traffic, even in areas with "historically high average rainfall." The combination of daily traffic and even a week of without rainfall can quickly destroy a quality grass paved area. Repaired areas also usually require supplemental water to establish grass.

The irrigation system can be a hose and sprinkler, a simple manual valve system, or an automatic pop-up system as appropriate for the owner's maintenance program and budget. Automatic irrigation systems are low in labor costs, provide quick response to usage, conserve water, and allow for easy and rapid fertilizer applications. Standard large diameter spray heads will keep the irrigation cost per square foot to a minimum. Manual systems have higher labor and water costs, and variable response to water needs.

Buried low-pressure porous pipe irrigation systems have also been used with success. This type of irrigation can work during daylight hours without wasteful spray damaging people or objects above the ground. However, grass leaves do not receive cleansing from water falling from above.

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Oil/Antifreeze Spills

Small Spills - Naturally occurring micro-organisms in turf can break down oil and "clean" spills prior to their reaching the water table below. Thus, turf is capable of accepting oil drippings without harm to grass plants. Small amounts of diluted detergent (dishwashing concentrates) applied to minor spills will also help to reduce oil particles to manageable size and speed recovery.

Large Spills - Large oil or antifreeze spills will effectively sterilize affected soils for years and prevent growth of most vegetation. Thus, affected soil, base course, rings, and grass should be replaced and soil disposed of according to local codes relating to hazardous materials.

To create a uniform edge for repair, use a sod cutter or circular saw with masonry blade to cut the upper 2" of soil and Grasspave² structure. Be sure to wear appropriate eye and body protection when cutting into rings, soil, and gravel. The disturbed base can be dug by shovel or backhoe depending on the size of the area. Replace materials per Grasspave² Installation Guide.

Rings--Repair When Exposed

When properly installed, Grasspave² units are protected from damaging ultraviolet (UV) rays, which make plastics brittle, because they lie just below the soil surface. When impressions of the rings are visible as creases in grass blades (during the growing season), or when actual rings are visible to the eye, immediately cover the exposed rings with sand topdressing to a depth of between 1/8" to 1/4" above the top of the rings. This is easily done by spreader equipment or with a shovel and rake.

Ruts

The appearance of ruts in grass paving is a sign of improper installation. Possible errors

include:

1. Improper depth of base, or inadequate compaction
2. "Topsoil" placed between base and Grasspave²
3. More than 1/2" of soil above top of rings

Contact the original contractor to repair and re-install to specifications.

Shade

As trees mature in the landscape, grass paved areas (especially those carrying daily traffic) can experience a loss of grass vigor due to increased levels of shade. Some grasses are more tolerant of shade than others and may have to be seeded into the affected area.

This can be done without removing the existing grass because a shade tolerant mix will overcome a weaker grass. For a more rapid and complete conversion, however, an application of a short-term herbicide such as Roundup can be applied according to manufacturer's recommendations in preparation for reseeding. Use reseeding steps in "Bare Spots--Repair" described on Page 3.

Grass paved areas not subject to daily traffic (such as firelanes) will probably not show any stress from shading.

Snow Removal

Grasspave² paved areas can be easily plowed of snow using standard truck-mounted snow plow blades with small skids on the corners to keep the bottom of the blade off grass surface by approximately 1". This minimizes surface skinning. This apparatus should be used regardless of the pavement surface type.

The Grasspave² paved area surface should be at, or slightly below, that of adjacent hard surfaces to avoid gouging. Grass plants are dormant in the winter and damage to grass blades will be replaced with new growth in the spring. Damage to grass crowns can be

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repaired by topdressing as described in "Bare Spot--Repair" on Page 3.

Avoid long-term pileup of snow on grass paved surfaces to minimize possible damage from snow mold and other related diseases. Snow melts from grass areas at about the same rate as that of asphalt.

Thatch Removal

Over time, most grass installations, including Grasspave² areas, will develop layers of thatch--usually defined as old leafless stems of grass, or layers of grass clipping in various state of decomposition. Thatch is a problem because it can prevent percolation and, if allowed to build layers over 1/2" in depth above rings, can allow compaction to take place above the Grasspave² structure. This layer of thatch must be removed for the long-term health of turf.

Different grasses require different techniques for thatch removal. The two most common methods are:

- Use of spring tines on rotary mower blades (best for buildup from clippings)
- Use of sod cutter, set to shallow depth to skim tops of rings (best for air/ waterborne soil deposits over long term)

Depending on the depth of thatch removed and the condition of grass crowns remaining, it may be necessary to topdress and reseed. (See "Bare Spots--Repair," page 3.)

Utilities--Subsurface Access

Subsurface utilities can be installed or repaired by cutting the Grasspave² structure and turf with a sod cutter (set to depth below the Grasspave²), pulling/rolling up the section, and setting it aside. To reinstall Grasspave², rebuild the base as in a new installation (See Grasspave² Installation Guide) and replace the Grasspave² and turf. Be sure to compact the base course material to 95% Proctor (3 to 4 passes with vibrating roller).

In the case of a broken water or gas line below Grasspave² paved areas, use a standard backhoe for rapid and easy emergency access. Reinstall following instructions for a new installation. If necessary, new Grasspave² units can be delivered by UPS Next Day anywhere in the country. The finish grade of base course (usually Finish Grade Less 1 Inch) can be used for temporary access until Grasspave² and grass are ready to complete the finish surface.

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Grasspave² Normal Maintenance Checklist

Function

Frequency

Aeration

NEVER AERATE GRASSPAVE² PAVED AREA

Fertilizing

As appropriate for selected grass species.

Herbicides/Insecticides

As needed, following manufacturer's instructions.

Irrigation

As appropriate for selected grass species and rainfall amounts in area.

Micronutrients

Apply 1 time year (or every 6 month growing season in warm climate areas).

Mowing

As appropriate for selected grass species.

Thatch Removal

Remove when reaches 1/2" in depth above rings.

1. Ensure that sandy gravel base is porous.
 - Run hose on base to make sure water flows into base.
 - If area has a low spot which collects water, provide subsurface drainage to remove excess water.
2. Apply Hydrogrow Soil Polymer to base.
 - Apply Hydrogrow Soil Polymer over the area by hand, or small fertilizer spreader, at a rate of 10 lbs per 1000 sf for use with sod, or seeding.

Warning - do not place any form of topsoil between sandy gravel base and Grasspave² unit!
3. Place Grasspave² units over base, use posts and rings to interlock. Cut with pruning shears or knife if needed.
 - Place Grasspave² units (with rings up) directly over the sandy gravel base. Use the posts and rings provided to connect the units.
 - If required, use pruning shears or sharp knife to cut web between rings to shape units. "U" shaped pins are not required, but can be used to secure unit to base if there is a slope or rapid speed and stopping involved.
4. Fill Grasspave² units with grass -
 - If seeding - fill mat area with clean sharp sand (washed concrete sand) to top of rings, broom to barely expose top of ring. Do not use "topsoil" to fill rings. Apply seed and mulch via hydroseeder, or similar. Topdress with concrete sand to depth of 1/4" thick max., 4 to 6 weeks after seeding, to cover tops of rings.
 - If sodding use thin (.5 inch, or 13 mm) sod - fill mat area with clean sharp sand (washed concrete sand) to top of rings (1 inch, or 25 mm), then place thin sod over sand with tight joints per normal installation. Do not use "topsoil" to fill rings.
 - If sodding with thin sod, fill rings with sand to allow sod soil to cover top of rings by 0.25"-0.5" (6 - 13 mm).
5. Irrigate, fertilize and maintain turf per normal lawn. Protect from traffic until turf root system is well established.

Grasspave² Installation Procedure

Gravelpave²- Maintenance Guide

by **Invisible Structures, Inc.**

Exposed Rings:

Gravelpave² typically requires very little maintenance. However, in high traffic areas, such as aisle ways or entrances/exits, the rings may become exposed as gravel is either compacted or transported. In these areas, it is suggested that excess gravel in surrounding areas is broomed or raked into the areas with poor coverage.

Potholes:

Potholes may appear if the base course was not of appropriate depth, compacted properly, or base gravel has been “pumped” into clay soil below. Should this occur, remove the affected section by vacuuming the gravel from the rings, unfasten the snap fastener, bring the base course to the proper grade and compaction put the Gravelpave² pieces back in place, anchor and refill the rings.

Tire or plow damage:

Gravelpave² can be damaged in the event that proper techniques/equipment are not used during plowing. Another cause of damage is when motorists “peel-out” on the Gravelpave². In both of these instances, the Gravelpave² may be reused if the damage does not significantly affect the shape or strength of the parts, otherwise new product will need to be used. To repair, simply re-level and compact the base course and then re-anchor and refill the rings.

Leave/Garbage:

Leaves and garbage should be raked, vacuumed (being careful not to remove the gravel), or moved with a blower. These materials should not be allowed to decay over the winter since organic matter will stimulate weed growth and reduce porosity.

Weed Growth:

To attack any occasional weeds that may locate within the Gravelpave² installation, spray them with a weed killer (such as RoundupTM) and remove them when dead.

Snowplowing:

Gravelpave² paved areas can be easily plowed of snow using standard truck-mounted snowplow blades with small skids on the corners of the blades to keep the bottom of the blade off the surface approximately 1”. This eliminates product damage and reduces gravel migration. The Gravelpave² surface should be at or slightly below, that of adjacent hard surfaces to avoid gouging. Avoid long-term pileup of snow on Gravelpave² surfaces to avoid concentrated sedimentation accumulation.

Adjacent tree or shrub watering:

Trees or other large shrubs adjacent or surrounding by Gravelpave² may, if necessary, be watered directly through Gravelpave² either manually with a hose or automatically with a drip-irrigation system.

Guidance to Help Local Governments Determine When Low Impact Development Practices Should Not Be Required

More and more local governments are taking steps to require the use of low impact development (LID) for stormwater management unless site and soil conditions make LID infeasible. Determining absolute infeasibility of LID best management practices (BMPs) is difficult and includes many factors related to a specific site, such as soil infiltrative capacity, depth to groundwater, existing and historic land use, and site location. This guidance is intended to help local governments that require the use of LID BMPs determine when site conditions are such that LID BMPs should not be required, and project proponents should be granted flexibility to use more conventional BMPs. For most LID BMPs, the infeasibility of LID is determined by site conditions, not financial costs. For the purpose of this guidance, we recommend that vegetated roofs and roof rainwater collection systems be the only LID BMPs that local jurisdictions use cost considerations as a factor in determining feasibility.

1. BIORETENTION

- **Soils:** Bioretention should not be required where the infiltration rate is less than 0.1 inches per hour. However, even on poor-draining soils with infiltration rates less than 0.1 inches per hour, bioretention may still be an option depending on the size, location, and amount of water the bioretention area is designed to hold, and if an underdrain is used.
- **Site Topography:** Bioretention should not be required on slopes of 10% or greater, unless designed by an engineer to meet specific topographical considerations.
- **Bluffs, Erosion Hazards, and Steep Slope Landslide Areas:**
 - Bioretention should not be required within any of these areas, as per the jurisdiction's critical areas ordinance.
 - Bioretention should not be required within a minimum of at least 50 feet from the tops of slopes >15%, as per the *Stormwater Management Manual for Western Washington, 2005*. Jurisdictions may wish to require that a qualified geotechnical engineer perform a detailed analysis before any site clearing, development or infiltration occurs near a potentially steep slope or shoreline bluff.
- **Drinking Wells and On-site Sewage Systems:**
 - Bioretention should not be required within locally required minimum setbacks from wellheads, on-site sewage systems, basements, foundations, and utilities.

- Bioretention should not be required within at least 100 feet from drinking water wells, septic tanks, drainfields, and springs used for drinking water supplies, as per the *Stormwater Management Manual for Western Washington, 2005*.
- **Depth to Water Table:**
 - Bioretention should not be required if there is less than a 1 foot separation from the seasonal high water mark to the bottom of the bioretention area where the contributing area of the bioretention has less than 5,000 square feet of pollution-generating impervious-surface; and less than 10,000 square feet of impervious surface; and less than $\frac{3}{4}$ acres of lawn.
 - Bioretention should not be required if there is less than a 3 feet separation from the seasonal high water mark to the bottom of the bioretention, where the contributing area of the bioretention area is equal to or exceeds any of the following limitations: 5,000 square feet of pollution-generating impervious surface; or 10,000 square feet of impervious surface; or $\frac{3}{4}$ acres of lawn and landscape (See Bioretention Areas in Chapter 7 of the *LID Technical Guidance Manual for Puget Sound, 2005*).

2. AMENDING CONSTRUCTION SITE SOILS.

- Amending soils disturbed by construction with compost should be required on every site.

3. PERMEABLE PAVING

- Permeable paving should not be required when the following site/soil conditions exist:
 - Sites where excessive sediment is deposited on the surface on a regular basis after construction (e.g., construction and landscaping material yards).
 - Sites that are downslope of steep, erosion prone areas that are likely to deliver sediment and clog the pervious pavement.
 - Sites where concentrated pollutant spills are possible such as gas stations, truck stops, and industrial chemical storage sites.
 - Sites where seasonally high groundwater creates prolonged saturated conditions at or near ground surface and within the pavement section.
 - Sites that receive regular, heavy applications of sand to maintain traction during winter.

- Sites with slopes greater than 5% unless permitted in the manufacturer's recommendations or unless a qualified engineer documents it is possible with adjustments to design.

4. DISPERSION INTO NATIVE VEGETATION AREAS

- Dispersion should not be required (and the flow credit should not be applied) where site conditions are not conducive to the minimum flow path, flow control, and dispersion area requirements set forth in BMP T5.30 of the *Stormwater Management Manual for Western Washington*, 2005.

5. VEGETATED ROOFS

- Vegetated roofs may be determined to be not required based on a cost evaluation.

6. MINIMAL EXCAVATION FOUNDATIONS

- Wall configurations should not be required on sites with slopes greater than 10%.
- Pier configurations should not be required on sites with slopes greater than 30% (unless a local critical areas ordinance contains siting limits less than 30%).
- Minimal excavation foundations should not be required where underlying soils are impenetrable due to excessively rocky conditions.

7. ROOF RAINWATER COLLECTION SYSTEMS

- Roof rainwater collection systems may be determined to be not required based on a cost evaluation.

Low Impact Development - an economic fact sheet

Low Impact Development mimics the natural water cycle of the landscape, reducing the negative impacts of storm water runoff pollution on streams and rivers.

Communities first learning about Low Impact Development (LID) often ask, “Does it cost more than conventional development?”

Decision makers may ask “How can we communicate the costs and benefits of LID to developers and citizens?”

The purpose of this factsheet is to provide basic economic information on Low Impact Development. This simplified overview of a complicated topic is intended to help citizens, developers, and policy-makers have an informed discussion about the costs, benefits, and trade-offs of LID in their community.

The importance of recognizing long-term benefits of LID and those benefits that are not easily monetized are also highlighted.

The factsheet is a summary of information from multiple sources, including some examples of LID economic studies. We are thankful for the original researchers’ and writers’ time and effort.

Every LID site will have different costs and benefits based on many things including the site itself, the development design, and construction costs. There is a perception that any change to traditional development norms, including new technology will have higher costs and less profit. Numerous examples in this factsheet prove otherwise. In addition, protecting natural ecosystems through sound LID practices provides numerous benefits to communities.

This fact sheet results from a project in Transylvania County, NC. A US Environmental Protection Agency grant provided through the NC Division of Water quality allowed NC Cooperative Extension and other partners to work with the Transylvania Natural Resources Council to involve the community in open discussions about the use of Low Impact Development to allow growth and protect natural resources.

A brief definition of LID

The purpose of LID is to mimic the natural water cycle of the landscape, reducing the negative impacts of storm water runoff pollution on streams and rivers. LID includes the following five basic strategies, with multiple techniques for each strategy:

Conserve resources. At the watershed, subdivision, project, and individual lot level, retain natural resources (trees, water, wetlands), drainage patterns, topography and soils whenever possible.

Minimize impact. At all levels, attempt to minimize the impact of construction and development on natural hydrologic cycles and ecological systems by conserving native vegetation, reducing grading and clearing, and decreasing impervious surfaces.

Optimize water infiltration. To the maximum extent practicable, slow runoff and encourage more infiltration and contact time with the landscape by retaining natural drainage patterns, reducing channelization, using vegetative swales, lengthening flow paths and flattening slopes.

Create areas for local storage and treatment. Rather than centralizing stormwater storage, distribute storage across the landscape, adjacent to areas of flow. Use small-scale best management practices (BMPs) such as raingardens and swales which allow for collection, retention, storage, infiltration, and filtering on-site.

Build capacity for maintenance. Develop reliable, long term maintenance programs with clear and enforceable guidelines. Educate homeowners, management companies, and local government staff on the operation and maintenance all practices, and about protecting water quality.

Are conservation developments (and cluster developments) LID?

A **conservation development** sets aside land in permanent easement that will not be developed. The remaining land is usually developed at higher densities, possibly allowing the same or more lots on less area. Typically, conservation developments protect 40% - 50% of the available land on a parcel. Many communities are familiar with the term cluster development. A **cluster development** places homes closer together on smaller lots. Whether or not land is set aside for protection depends upon the local government's ordinance or subdivision regulations.

LID may include conservation development and vice versa, but neither completely incorporates the goals of the other. For example, LID may be used within a highly developed downtown urban area. It is also possible for conservation developments to protect land while at the same time using conventional stormwater management practices that may not optimize water infiltration and treatment.

Defining the terms and goals of various types of development will help a local community to clarify whether they are meeting these goals.

*Assessing the economics of LID*⁸

Three methods are mainly used to assess the economics of LID.

Most often **cost comparisons** are performed using the initial construction costs only. By not including benefits of improved stormwater management and reduced maintenance costs, this method gives an incomplete assessment. However a cost comparison is the simplest to perform and therefore the most widely available.

The next type of assessment is a **life-cycle cost analysis**, which includes planning, design, installation, operation and maintenance (O&M) and decommissioning. This analysis, although more complete than construction cost only, still excludes economic benefits and ignores differences in effectiveness.

The third analysis, **benefit-cost analysis**, considers the full range of costs and benefits, including the long term life cycle costs of the construction, but also the economic benefits resulting from LID. This analysis requires more data and time, costs more to produce, and is therefore less often undertaken.

Environmental goods and services, such as clean air, clean water, or healthy fish populations, are not easily measured in monetary terms because they aren't traded in markets like consumer items such as houses, oil or timber. Yet, environmental goods and services are at the heart of our quality of life, and have value even if we don't observe "market prices" for them. Benefit-cost analysis of LID programs needs to include the value of these goods and services to society in order to be accurate. Estimation of these values is called **non-market valuation**.

What are some economic benefits of LID?

Example benefits to homeowners:

- Reduced flooding – onsite stormwater management reduces downstream flooding. A marginal reduction in flooding increases floodplain property values by up to 5%.⁵
- Reduced cooling costs – reduced pavement and increased natural vegetation reduced home energy bills by 33-50% compared to surrounding neighborhoods in Davis CA.⁶
- Increased amenity values – a preliminary analysis concluded that Seattle’s BMP retrofitted “greenstreets” added 6% to the value of properties.⁸
- Significant improvement in water quality can increase market value by 15% for properties bordering the water body.⁵
- Reduced stormwater fees if local government charges fees based on impervious surface.
- Reduced cooling needs because more trees and greenspace are retained.

Example benefits to local governments:

- Protecting water quality helps protect real estate values, which protects tax revenues.
- Reduced inflow and infiltration – less stormwater leaking into sanitary sewers means less volume of water reaching sewage treatment plant.
- Reduced filtration costs – bioretention instead of piped stormwater and sand filters saved \$250,000 along Anacostia River in Washington, DC.⁶
- Reduced public expenditures on stormwater infrastructure including expensive retrofits.
- Reduced system-wide operations and maintenance costs of pipe infrastructure.
- Extension of the useful life of central pipe infrastructure as populations increase.
- Reduced regulatory costs associated with water-quality impacts, such as threats to sensitive species, TMDL compliance, etc.

(Continued on page 5)

What are some economic benefits of LID?

(Continued from page 4)

Example benefits to developers:

- Increased number of buildable lots – reducing the need for stormwater retention ponds may result in more lots available for homesites.
- Less spent on infrastructure - replacing curb, gutter, and storm sewers with roadside swales saved one developer \$70,000 per mile, or \$800 per residence.⁸
- Increased property values – lots in LID neighborhoods sold for \$3000 more than lots in competing areas not using LID.⁸
- Initial savings from LID are usually accomplished through less conventional stormwater infrastructure, less paving, and lower site preparation costs.

Example benefits to the community:

- Protecting natural ecosystems through sound LID practices provides benefits to communities such as: reduced flooding, improved water quality, increased groundwater recharge, improved air quality, enhanced aesthetics, enhanced property values, increased open space, and carbon sequestration. These are all **ecosystem services**.
- Protecting water quality through LID maintains the value of clean water, which is usually less expensive than cleaning contaminated water. Not having to clean contaminated water is an **avoided cost**.
- Clean water is a quality of life benefit: although difficult to quantify, its value may rival or exceed more tangible benefits. For example, protecting human health is the driving force behind the nation's water supply protection program.
- Reduced flooding, reduced stream erosion, and reduced pollutant loading to downstream waters.

A sampling of economic studies

- In the Central Valley of CA, for every 1,000 deciduous trees, stormwater runoff is reduced nearly 1 million gallons – a value of almost \$7,000 per storm event.⁶
- In Maryland and Illinois studies show new residential development using LID infrastructure stormwater controls saved \$3500 - \$4500 per lot (1/4-1/2 acre) compared to new development with conventional stormwater controls. In addition to lowering costs for developer, these sites discharged less stormwater than conventional developments.⁶
- Pilot project estimates suggest LID projects can be completed at a cost reduction of 25-30% over conventionally developed projects. The need for costly stormwater ponds, drainage pipes, curbs, gutters, wide streets is eliminated or greatly reduced. These costs are usually much higher than the LID costs of relatively inexpensive features such as bioretention raingardens, wetlands, cisterns, etc.²
- Homebuyers' willingness to pay for amenity values in the Shepards Vineyard housing development, Apex NC, added \$5000 to the price of 40 homes adjacent to the regional greenway, and those homes were still the first to sell.¹³
- The Auburn Hills subdivision in Wisconsin used LID stormwater management, preserved 40% of the site as open space, and saved \$761,396 even with the inclusion of higher landscaping costs for LID development.³
- The Gap Creek subdivision in Sherwood, Arkansas revised an original subdivision plan and included LID concepts. Open space was increased from 1.5 acres to 23.5 acres. Lots sold for \$3000 more and cost \$4,800 less to develop, resulting in \$2.2 million additional profit to the developer.³
- The Prairie Glen Subdivision in Germantown, Wisconsin preserved 59 % of the site as open space, incorporating LID and conservation subdivision design. Hiking trails within the site gave residents easy access to the natural areas. Savings resulted from LID stormwater management, reduced infrastructure for roads, utilities, and water distribution. The design resulted in a savings of over \$600,000 compared to conventional subdivision design.³
- Implementing LID in Lockwood Folly, Brunswick County, NC would reduce the size of the required stormwater pond, making room for an additional home, and increasing developer revenues by up to \$91,000. ⁴
- The Congaree Bottom Hardwood Swamp outside Columbia, SC is a natural water quality improvement facility, filtering toxins, sediment and nutrients from runoff. Replacing this with man-made infrastructure would cost \$6.7 million in 2003 dollars. ⁹

Thinking about the tradeoffs: discussing the economics of LID

- Operation and maintenance (O&M) of stormwater management systems is not paid by developers, but by local government, homeowners, or HOAs. It is important to consider these costs and who bears them.
- Traditional development removes rainfall from sites as quickly as possible, increasing environmental and management costs. Which is more costly: (1) a private landowner handling rain where it falls, or (2) all private landowners passing the rain to a public entity to handle?
- When development causes damage to natural resources and diminishes ecosystem services, the true costs of that development may be hidden. Historically these costs are paid by citizens in the form of increased water filtration, reduced aesthetics, and decreased property values.
- Communities have two types of stormwater management assets - natural (wetlands, forests, etc) and structural (pipes, facilities). Reducing natural assets may require an increase in structural assets. Protecting natural systems provides multiple benefits at lower costs.
- Recent research at Duke University shows that it is cheaper to build conservation developments than conventional developments in western NC.¹⁵
- Consider retrofitting existing development with LID practices during regular operation and maintenance.
- Shifting storm water maintenance to the private landowner may be problematic. Some local governments handle this by requiring stormwater management to occur on jointly held homeowner association property with easements, as compared to on private landowner lots. Regular inspection is necessary.
- A benefit-cost analysis provides decision makers and stakeholders with a more complete picture for evaluating trade-offs of different development types.
- When considering the tradeoffs of development it is imperative that all benefits and costs associated with each option are measured. Non-market values for ecosystem services are becoming more available and should be considered when discussing the relative benefits and costs of LID and traditional development.



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www.ncsu.edu/weco

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Low Impact Development

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American Planning Association

Making Great Communities Happen

Articles

DeLaria, Michelle. 2008. "Low Impact Development as a Stormwater Management Technique." Rocky Mountain Land Use Institute Sustainable Community Development Code Research Monologue Series: Environmental Health and Natural Resources.

- Defines stormwater management and LID; includes strategies on how to integrate LID strategies into local land use codes.

Foss, Asa. 2005. "Low Impact Development: An Alternative Approach to Site Design." *PAS Memo*, May/June.

- Provides an overview of LID's four areas of emphasis: stormwater management, wastewater management, circulation design, and site design, along with examples of incorporating LID into practice.

Guillette, Anne. 2008. "Achieving Sustainable Site Design through Low Impact Development Practices." National Institute of Building Sciences Whole Building Design Guide, www.wdbg.org.

- Discusses LID site design goals, strategies, and the site planning process; suggests LID technologies for different levels of water conservation.

Nisenson, Lisa. 2006. "Integrating Stormwater Regulation and Urban Design." *Zoning Practice*, November.

- A primer on EPA rules requiring the integration of stormwater management with local planning and zoning efforts.

Weinstein, Noel and John Tippet. 2003. "Low Impact Development Strategies for Rural Communities." Paper presented at National Conference on Urban Stormwater: Enhancing Programs at the Local Level, Chicago, IL, February 17-20.

- Case study documenting the experience of one rural Virginia community in incorporating LID into their local resource protection and regulatory programs.

Reports

Lehner, Peter, et al. 2001. "Chapter 12. Low Impact Development" in *Stormwater Strategies: Community Responses to Runoff Pollution*. New York, NY: Natural Resources Defense Council.

- Provides definition for LID and details seven benefits. Includes 11 case studies.

NAHB Research Center, Inc. 2003. *The Practice of Low Impact Development*. Washington D.C.: PATH and HUD Office of Policy Development and Research.

- Includes primer on LID, overview of LID tools and techniques, circulation and design guidelines. Appendix includes 6 case studies.

U.S. Environmental Protection Agency, Office of Water. 2007. *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*. EPA-841-F-07-006. Washington, DC: U.S. Environmental Protection Agency.

- Summarizes 17 case studies of developments using LID techniques and concludes that LID reduces project costs and improves environmental performance.

U.S. Environmental Protection Agency, Office of Water. 2000. *Low Impact Development: A Literature Review*. EPA-841-B-00-005. Washington, DC: U.S. Environmental Protection Agency.

- Early review of LID practices and effectiveness. Includes six detailed case studies.

Technical Manuals

Charlotte-Mecklenburg (North Carolina), City-County of. 2008. *Charlotte-Mecklenburg BMP Design Manual*. Revised. Chapter 2. Ordinances. Chapter 4. Structural Storm Water Controls.

- Provides examples of determining low and high density thresholds; detailed technical descriptions of 10 BMPs including summary fact sheets, design requirements, and design procedures.

Pierce (Washington), County of, Surface Water Management. 2009. *Pierce County Draft Stormwater Management and Site Development Manual*. Volume VI. Low Impact Development.

- Provides illustrated LID site design criteria and information on 13 BMPs.

Prince George's (Maryland), County of, Department of Environmental Resources. 1999. *Low-Impact Design Strategies: An Integrated Design Approach*.

- Classic LID guidebook exploring site planning, hydrologic analysis, integrated management practices, erosion and sediment control, and public outreach; includes sample maintenance contract.

San Diego (California), County of, Department of Planning and Land Use. 2007. *Low Impact Development Handbook: Stormwater Management Strategies*.

- Introduces LID, provides LID site planning principles and design examples for residential, commercial, and industrial development, and describes IMPs in hydrologic design and for permeable pavement, roads, parking lots, buildings, and landscaping.

Model Ordinances

Massachusetts Executive Office of Environmental Affairs. 2006. "Model Low Impact Development (LID) Bylaw" in *Massachusetts Smart Growth Toolkit*.

- Model LID bylaw and regulations; includes performance standards and provisions for inspection. Appendix covers LID credits and incentives

Vermont League of Cities and Towns. 2008. "Managing Stormwater through Low Impact Development (LID) Techniques." Municipal Assistance Center Technical Paper #5. Includes Model Low Impact Development Stormwater Management Bylaw.

- Model bylaw includes both pre-development and post-construction site standards.

Sample Ordinances

Fauquier (Virginia), County of. 2008. *A Zoning Ordinance Text Amendment to Sections 5-006.5, 12-610 and 15-300 Related to Utilization of Low Impact Development Techniques With Site Development*.

- Ordinance amends definition of LID, introduces LID standards into special permit and site plan drainage requirements.

Issaquah (Washington), City of. 2008. *Municipal Code*. Title 13, Public Services. Division I, Water. Chapter 13.28. Stormwater Management Policy. Section 13.28.055. Drainage Review – Deviations for Low Impact Development Proposals.

- Authorizes deviations from regular standards for LID proposals achieving low impervious surface development goals.

Lacey (Washington) City of. 1999. *Lacey Municipal Code*. Title 14: Buildings and Construction. Chapter 14.31, Zero Effect Drainage Discharge.

- Defines “zero effective impervious surface” and authorizes deviations from existing engineering and public works standards to achieve this goal.

Lower Makefield (Pennsylvania), Township of. 2007. *An Ordinance of the Township of Lower Makefield, Bucks County, Pennsylvania, Amending the Provisions of the Lower Makefield Township Code Related to Subdivision and Land Development to Provide for Low Impact Development Design Standards and Storm Water Management Practices*. Ordinance No. 363. *An Ordinance of the Township of Lower Makefield, Bucks County, Pennsylvania, Amending the Lower Makefield Township Codified Zoning Ordinance of 1996, as Amended, so as to Provide for Low Impact Development Standards*. Ordinance No. 364.

- Ordinances amend existing zoning code and subdivision regulations to include LID standards.

Port Angeles (Washington), City of. 2008. *Municipal Code*. Title 17. Zoning. Chapter 17.44. PLID – Planned Low Impact Development Overlay Zone.

- Planned Low Impact Development allows flexibility of site design to create high-quality residential development that conserves onsite natural features and uses small-scale engineered hydraulic controls to mimic predevelopment hydrologic conditions.

Sammamish (Washington), City of. 2008. *An Ordinance of the City of Sammamish, Washington, Amending the City of Sammamish Municipal Code to Create a Low Impact Development Chapter, and Amending Certain Other Chapters to Ensure Consistency with the Low Impact Development Chapter*. Ordinance No. O2008-236.

- Adds LID chapter to municipal code encouraging comprehensive incorporation of LID into project design. Use of BMPs earns Technique Points toward incentives including density and height bonuses.

Santa Monica (California) City of. 2000. *Municipal Code of Ordinances*. Article 7, Public Works. Chapter 7.10. Urban Runoff Pollution.

- Sets “good housekeeping requirements” and establishes Best Management Practices to maximize on-site absorption of stormwater and minimize pollution of urban runoff.

Snohomish (Washington), County of. 2009. *Unified Development Code*. Chapter 30.63C. Low Impact Development.

- Incorporates the LID Technical Guidance Manual for Puget Sound by reference, mandates LID use in certain locations. Authorizes modifications to bulk regulations, PRDs, and construction, drainage, grading, and access standards for LIP project proposals.

Stafford (Virginia), County of. 2008. *Stafford County Code*. Chapter 21.5, Article I. Stormwater Management.

- Incorporates LID manuals by reference. Provides special requirements for low impact development site stormwater management design plans.

Additional Online Resources

Green Roofs for Healthy Cities. <http://www.greenroofs.org/>

Low Impact Development Center, Inc.
<http://www.lowimpactdevelopment.org/home.htm>

Metropolitan Area Planning Commission- Massachusetts Low Impact Development Toolkit. <http://www.mapc.org/LID.html>

National LID Clearinghouse. <http://www.lid-stormwater.net/clearinghouse/>

Puget Sound Online Low Impact Development Resources.
<http://www.psp.wa.gov/stormwater.php>

Seattle, Washington Street Edge Alternatives (SEA Streets) project.
http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.asp

U.S. EPA's Low Impact Development Website. <http://www.epa.gov/nps/lid/>

U.S. EPA's National Pollutant Discharge Elimination System Stormwater Program.
http://cfpub.epa.gov/npdes/home.cfm?program_id=6

University of New Hampshire Stormwater Center – Nonpoint Education for Municipal Officials (NEMO) Innovative Stormwater Management Inventory.
<http://www.erg.unh.edu/stormwater/index.asp>

LID INCENTIVES: The following list includes incentives that have been considered by communities looking to encourage low impact development. The bulleted items below each incentive identify issues that should be considered before pursuing the incentive.

Increased Densities

- Allow greater residential densities with the implementation of LID techniques.
- With more sensitive design the land is able to manage more units.
- Potentially greater impacts needing mitigation.

Reduced Review Time / Expedited Review

- Commit to a priority status on LID projects with a maximum time between receipt and review.
- LID projects may need special studies and reviews that must be identified early.
- Impacts to staffing resources and other project review schedules. Outside consultants could also be used to expedite.

Property Tax Reduction

- Reduce or waive property taxes on an LID project for a given number of years.
- Lower service requirements result from lower impacts.
- Reduced revenues.

Reduced Application Fees

- Waive all or a portion of the submittal fees on LID projects.
- Due to lesser impacts to the community, lower fees are charged.
- Impacts to jurisdiction resources. May be offset by reduced habitat restoration and environmental costs

Public Recognition

- Emphasize LID projects on website, at Council meetings and in utility mailers.
- Highlight the great development projects going on throughout the area & create public awareness.
- Staff resource impacts.

Dedicated Review Team

- Create an LID review team that is familiar with and dedicated to LID projects.
- Specialized team with technical expertise is necessary and more efficient assistance and review.
- Initial training of team members in LID techniques will be required in any event. Outside consultants could also be used - charged to applicant or paid for by jurisdiction.

Flexibility in Bulk, Dimensional & Height Restrictions

- Allow greater building heights and floor area ratios as well as reduced setbacks.
- Provides flexibility in overall site design. Allows reduction in building footprint. Addresses clustering needs.
- Consistency/compatibility with existing development and urban design goals.

Adjustments to the Required Parking

- Reduce parking requirements.
- Reducing parking is both an LID technique for reducing impervious surfaces as well as a way to encourage more projects.
- May conflict with other community objectives.

Lower Stormwater System Development Fees

- Reduce charges when development meets thresholds.
- Lower impacts to system capacity, so lower fees are appropriate.
- Reduced capital funds. Compensate by raising charges for conventional developments.

Fee Structure

- Develop a new fee structure that is based on impervious surface. Fee reduction will be awarded based on LID implementation thresholds

Reduced Requirements for Conventional Stormwater Management

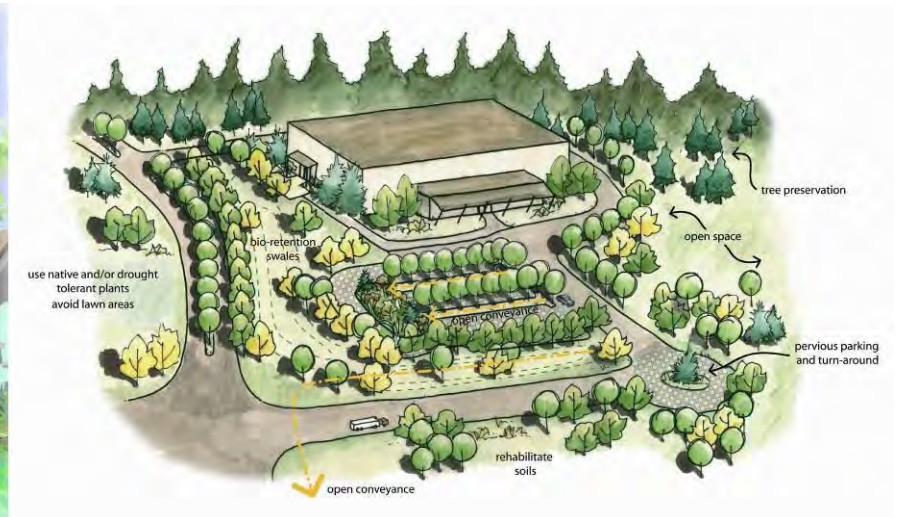
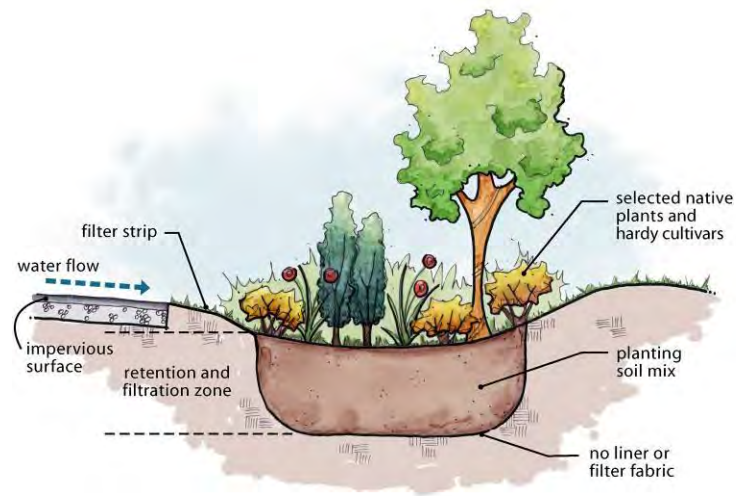
- Allow developers to reduce the amount of conventional stormwater management when they implement LID or LID techniques. Example, if roof runoff is re-used onsite, or infiltrated on-site, the development can remove the roof square footage in the calculations for determining detention pond size.

Jurisdiction-Furnished LID Materials

- Jurisdiction will supply materials (pervious concrete, plants, soil, mulch, compost, etc) to offset development costs on LID projects.

Maintenance of Low Impact Development Facilities

Revised December, 2008



Prepared by:



For:

PugetSoundPartnership
our sound, our community, our chance

Maintenance of Low Impact Development Facilities

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Maintenance of Low Impact Development Facilities

A. Introduction

The maintenance of LID facilities is essential to ensure that designed stormwater management performance and other benefits continue over the full life cycle of the installation. Some of the maintenance agreements and activities associated with LID practices are similar to those performed for conventional stormwater systems; however, the scale, location, and the nature of a LID approach will also require new maintenance strategies.

The following outlines typical maintenance goals and objectives, types of maintenance agreements and training, and provides matrices with maintenance activities and schedules for bioretention areas, amended construction site soils, permeable paving, vegetated roofs, and roof rainwater collection systems.

1. *Goals and Objectives*

Many maintenance goals of LID facilities will be similar throughout the Puget Sound region. The following provides a standard set of goals that can be added to or modified according to the specific physical settings and needs of a local jurisdiction.

A) Flow Control and Drainage

- Maintain infiltration capacity within facility.
- Maintain detention capability within facility to reduce peak flows.
- Safely convey design storm flows.

B) Water Quality Treatment

- Maintain pre-development infiltration and detention capability.
- Preserve soil and plant health and contact of storm flows with those plant soil systems.

C) Safety and Emergency Vehicle Access

- Maintain adequate sight distances.
- Create signage for emergency vehicle access and facilities.
- Ensure the sufficient carrying capacity for emergency vehicles of any permeable load-bearing surfaces.

D) Cost Effectiveness

- Maintain facilities for long-term, high quality performance at a cost that is equal to, or less than, conventional systems.
- Prevent expensive repair of large scale or catastrophic problems through continued routine procedures.

E) Aesthetics

- Develop LID facilities as a landscape amenity as well as a stormwater management system.

F) Public Health

- Minimize potential for disease transmission and mosquito breeding by maintaining designed infiltration capacity, storm flow conveyance, ponding depths, and dewatering rates.

G) Community Participation

- Provide educational materials to homeowners and commercial property owners explaining the benefits, function, and importance of community participation for the long-term performance of LID facilities.

2. *Support Strategies*

Effective measures to support and ensure quality maintenance of LID facilities include education, incentives, and regulations. In order to provide the most effective maintenance programs, a variety of strategies should be selected from the list below.

A) Education

- Simple, concise messages delivered throughout the project life cycle.
- Brochures explaining the functions, benefits, and responsibilities of facilities at transfer of deed.
- Information bulletins over public access channels.
- Community volunteers providing informal workshops.
- Ongoing involvement of developer with community groups.
- Training programs for those maintaining the systems.

B) Incentives

- Reduce stormwater utility fees for individual homeowners or commercial properties.
- Provide support for property owners with technical advice and materials, such as mulch and plants.
- Provide awards and recognition to innovative developers and communities that build and properly maintain LID facilities.

C) Regulations

- Require maintenance plans and agreements prior to project approvals. (These would include a list of all proposed facilities, facility locations, a schedule of maintenance procedures, monitoring requirements, if any, and an agreement that all subject properties are collectively liable for the ongoing maintenance of the facilities.)
- Mandate jurisdictional maintenance and additional taxes for funding.
- Require fines for corrective actions.
- State that maintenance responsibilities and liabilities are shared by all property owners for projects with facilities designed to serve multiple properties or owned and/or maintained collectively.
- Require deed restrictions or covenants conveyed with deed for the full life cycle of all project types.

3. *Maintenance Responsibilities*

Low Impact Development facilities range in size and complexity. Accordingly, entities responsible for maintenance should be appropriately matched to the tasks required to ensure long-term performance. An individual homeowner may be able to reasonably maintain a rain garden, permeable driveway, or other small facility; however, larger facilities are often maintained through private parties, shared maintenance agreements or the presiding jurisdiction. In addition, the use and ownership of properties can often help dictate the most appropriate means of facility maintenance. Below are some general guidelines for the three primary categories of Maintenance Responsibilities.

A) Property Owners

- Are usually responsible for small facilities located on an individual property.
- Require basic knowledge and understanding of how the system functions.
- Jurisdiction(s) can improve system function over time by offering basic training to property owners.
- Should know when to seek and where to find technical assistance and any additional information.
- Requirements for maintenance should be conveyed with deed.
- Failure to properly maintain LID facilities may result in jurisdictional liens.

B) Private Parties

- Handle the widest range of LID projects in size and scope.
- Handle most commercial or multi-family properties. Copies of agreement may be required prior to project approval.
- Unique maintenance agreements should be developed based on the scale, use, and characteristics of the site and conservation areas, as well as level of expertise of the property owner and the responsible jurisdiction.
- Maintenance agreements can be between a variety of parties, such as individual homeowners, property owner associations, or even jurisdictions.
- Outside groups responsible for maintenance should be trained in the design, function, benefits, and maintenance of LID facilities.
- Recognize that integrated LID management practices require more frequent inspection than conventional facilities.
- Third-party maintainers should provide documentation to the property owners of the type of maintenance performed, a certificate of function, and any non-routine maintenance needs requiring specialized corrective actions.
- Jurisdictions may choose to provide an educational course for prospective maintenance parties and a list of approved or recommended parties.

C) Jurisdictions

- Will handle most public LID infrastructure.
- Should be prepared to handle non-routine maintenance issues for a variety of facilities.
- Maintain primarily large facilities, except for those requiring corrective action.
- Private LID facilities requiring corrective action may require a jurisdiction to hire a private party or use their own staff to complete the work. Property owners should be billed for these expenses.

4. Inspections

Regular and appropriately timed inspections are necessary for the proper operation of LID facilities over the full life cycle of the installation. Inspectors should be trained in the design and proper function and appearance of LID practices. Inspections should be seasonally timed in order to have early detection, repair and efficiency. These inspections should include the following: During Fall to clear debris and organic material from structures and prepare for impending storms; early winter storm events to confirm proper flow control operation and to identify any erosion problems; before major horticultural cycles (i.e., prior to weed varieties dispersing seeds); and any other regularly scheduled maintenance activities. To ensure continuity and to better identify trends in the function of facilities, the same individual(s) should inspect the same drainage area. Finally, LID facilities are integrated into the development landscape and willing homeowners can provide frequent inspection and identification of basic problems with minimal training.

B. Bioretention Maintenance Schedule

Bioretention areas require annual plant, soil, and mulch layer maintenance to ensure optimum infiltration, storage and pollutant removal capabilities. The majority of routine maintenance procedures are typical landscape care activities and can be performed by various entities including individual homeowners.

Routine

Activity	Objective	Schedule	Notes
Watering: Maintain drip irrigation system without breaks or blockages. Hand water as needed for specific plants.	Establish vegetation with a minimum 80% survival rate.	Twice annually (May and July) or as indicated by plant health.	Plants should be selected to be drought tolerant and not require watering after establishment (2-3 years). Watering may be required during prolonged dry periods after plants are established.
Clean curb cuts: Remove any accumulation of debris from gutter and entrance to bioretention area.	Maintain proper flow of stormwater from paved/impervious areas to bioretention facility.	Twice annually (October and January)	
Remove and/or prune vegetation	Maintain adequate plant coverage and plant health. Reduce shading of under-story if species require sun. Maintain soil health and infiltration capability. Maintain clearances from utilities and sight distances.	Once or twice annually.	Depending on aesthetic requirements, occasional pruning and removing dead plant material may be necessary.
Weeding: Remove undesired vegetation by hand.	Reduce competition for desired vegetation. Improve aesthetics.	Prior to major weed species disbursing seeds (usually twice annually)	Periodic weeding is necessary until plants are established. The weeding schedule should become less frequent if the appropriate plant species and planting density have been used and, as a result, undesirable plants excluded.
Mulching: Replace or add mulch with hand tools to a depth of 2-3 inches.	Replenish organic material in soil, reduce erosion, prolong good soil moisture level, and filter pollutants.	Once annually or every two years.	Consider replacing mulch annually in bioretention facilities where high pollutant loading is likely (e.g. contributing areas that include quick marts). Use compost in the bottom of the facility and wood chips on side slopes and rim (above typical water levels).
Trash removal	Maintain aesthetics and prevent clogging of infrastructure.	Twice annually.	
Maintain access to infrastructure: Clear vegetation within 1 foot of inlets and out falls, maintain access pathways.	Prevent clogging of infrastructure and maintain sight lines and access for inspections.	Once annually.	

Bioretention Maintenance Schedule (cont.)

Non routine

Activity	Objective	Schedule	Notes
Erosion control: Replace soil, plant material, and/or mulch layer in areas if erosion has occurred.	Reduce sediment transport and clogging of infrastructure. Maintain desired plant survival and appearance of facilities.	Determined by inspection.	Properly designed facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems persist, the following should be reassessed: (1) flow volumes from contributing areas and bioretention cell sizing; (2) flow velocities and gradients within the cell; and (3) flow dissipation and erosion protection strategies in the pretreatment area and flow entrance.
Sediment removal: Shovel or rake out sediment within vegetated areas. Vactor catch basins or other sediment structures.	Reduce sediment transport and clogging of infrastructure. Maintain desired plant survival and appearance of facilities. Maintain proper elevations and ponding depths.	Determined by inspection.	If sediment is deposited in the bioretention area, immediately determine the source within the contributing area and stabilize.
Clean under-drains: Jet clean or rotary cut debris/roots from under-drains.	Maintain proper subsurface drainage, ponding depths, and dewatering rates.	Determined by inspection of clean-outs.	
Clean intersection of pavement and vegetation: Remove excess vegetation with a line trimmer, vacuum sweeper, rake or shovel.	Prevent accumulation of vegetation at pavement edge and maintain proper sheet flow of stormwater from paved/impervious areas to bioretention facility.	Determined by inspection.	Bioretention facilities should be designed with a proper elevation drop from pavement to vegetated area to prevent blockage of storm flows by vegetation into infiltration area.
Replace vegetation: Reseed or replant bare spots or poor performing plants.	Maintain dense vegetation cover to prevent erosion, encourage infiltration and exclude unwanted weed species.	Determined by inspection.	If specific plants have a high mortality rate, assess the cause and replace with appropriate species.
Replace soil: Remove vegetation (save as much plant material as possible for replanting) and excavated soil with backhoe, excavator or, if small facility, by hand.	Maintain infiltration, soil fertility, and pollutant removal capability.	Determined by inspection (visual, infiltration, pollutant, and soil fertility tests).	Soil mixes for bioretention facilities are designed to maintain long-term fertility and pollutant processing capability. Estimates from metal attenuation research suggest that metal accumulation should not present an environmental concern for at least 20 years in bioretention systems. Replacing mulch in bioretention facilities where heavy metal and hydrocarbon deposition is likely provides an additional level of protection for prolonged performance.
Rebuild or reinforce structures: Various activities to maintain walls, intake and outfall pads, weirs, and other hardscape elements.	Maintain proper drainage, and aesthetics and prevent erosion.	Determined by inspection.	
Re-grade or re-contour side slopes: Maintain proper slope with hand tools, back hoe or excavator, replant exposed areas.	Prevent erosion where side slopes have been disturbed by foot or auto traffic intrusion.	Determined by inspection.	

C. Compost Amended Construction Site Soil Maintenance Schedule

Compost amendments enhance the water storage and pollutant filtering capability of disturbed soils and improve plant performance on construction sites.

Routine

Activity	Objective	Schedule	Notes
Add compost or mulch: Spread material by hand to minimize damage to plant material.	Maintain organic matter content of soil, optimize soil moisture retention, prevent erosion, and enhance plant growth and survivability.	Once every one or two years.	Compost amended landscapes are stormwater management facilities and pesticide inputs should be eliminated or used only in unusual circumstances. Landscape management personnel should be trained to adjust chemical applications accordingly.

D. Permeable Paving Maintenance Schedule

The following matrices provide general maintenance recommendations applicable to all permeable paving and specific procedures for asphalt, concrete, Eco-Stone pavers, and Gravelpave2.

Routine

Activity	Objective	Schedule	Notes
All permeable paving surfaces			
Erosion and sediment control: Mulch and/or plant all exposed soils that may erode to paving installation.	Minimize sediment inputs to pavement, reduce clogging and maintain infiltration of pavement.	Once annually.	Erosion control is critical for long-term performance of permeable paving.
Permeable asphalt or concrete			
Clean permeable paving installation: Use street cleaning equipment with suction, sweeping and suction or high-pressure wash and suction.	Maintain infiltration capability.	Once or twice every year.	Street cleaning equipment using high-pressure wash with suction provides the best results for improving infiltration rates. Sweeping with suction provides adequate results and sweeping alone is minimally effective. Hand held pressure washers are effective for cleaning void spaces and appropriate for smaller areas such as sidewalks (may require special spray nozzle).
Remove snow: Use conventional snow removal techniques.	Maintain access.	Determined by inspection/snow depth.	
Eco-Stone pavers			
Clean permeable paving installation: Use street cleaning equipment with sweeping and suction when surface and debris are dry.	Maintain infiltration capability.	Once annually.	Washing should not be used to remove debris and sediment in the openings between the pavers. Vacuum settings may have to be adjusted to prevent excess uptake of aggregate from paver openings or joints.
Remove snow: Use snow plow with skids or rollers to slightly raise blade above pavers.	Maintain access.	Determined by inspection/snow depth.	The structure of the top edge of the paver blocks reduces chipping from snowplows. For additional protection, skids or rollers on the corner of plow blades are recommended.
All permeable paving surfaces			
Backfill utility cuts: Use same aggregate base as under permeable paving.	Maintain conveyance of stormwater through base and prevent migration of fines from standard base aggregate to the more open graded permeable paving base material.	Determined by inspection.	Small utility cuts can be repaired with permeable top course or with conventional asphalt or concrete if small batches of permeable material are not available or are too expensive.

Permeable Paving Maintenance Schedule (cont.)

Non-routine

Activity	Objective	Schedule	Notes
Eco-Stone pavers			
Replace aggregate in paver cells: Remove aggregate with suction equipment.	Maintain infiltration capacity.	Determined by inspection.	Clogging is usually an issue in the upper most few centimeters of aggregate. Check infiltration at various depths in the aggregate profile to determine excavation depth.
Utility maintenance: Remove pavers individually by hand and replaced when utility work is complete.	Repair utilities, maintain structural integrity of pavement.	When maintaining utilities.	Pavers can be removed individually and replaced when utility work is complete.
Replace broken pavers: Remove individual pavers by hand and replace.	Maintain structural integrity of pavement.	Determined by inspection.	
Gravelpave ²			
Clean permeable paving installation: Use vacuum trucks for stormwater collection basins to remove and replace top course aggregate if clogged with sediment or contaminated.	Restore infiltration capability.	Determined by inspection.	Permeable gravel paving systems have a very high void to surface coverage ratio. System failure due to clogging is unlikely except in unusual circumstances.
Replenish aggregate material: Spread gravel with rake	Maintain structural integrity.	Determined by inspection.	Gravel level should be maintained at the same level as the plastic rings or slightly above the top of rings. In high traffic areas, such as aisle ways, entrances or exits, gravel may become compacted or transported.
Remove and replace grid segments: Remove pins, pry up grid segments, replace gravel.	Maintain structural integrity.	Determined by inspection.	Replace grid segments where three or more adjacent rings are broken or damaged. Potholes should be remedied in the same way; the base course should be brought to the proper grade and compaction before replacing grid.
Remove snow: Use snow plow with skids or rollers to slightly raise blade above gravel surface.	Avoid concentrated sedimentation accumulation.	Determined by inspection/snow depth.	Elevating blades at least one (1) inch above the aggregate surface prevents loss of top course aggregate and damage to plastic grid.
Grasspave ²			
Aeration: (see note)			Do not Aerate Grasspave² installations. Aeration equipment will damage the structure of Grasspave ² and could prevent its long term function. Soil compaction and poor water penetration can be the result of soil types or local conditions and should be treated accordingly.
Replace Grasspave² installation: Place units over porous gravel base, fill with grass.	Restore system capability.	Determined by Inspection.	Do not place any form of topsoil between sandy gravel base and Grasspave ² units.

Invasive or nuisance plants: Remove manually and without herbicide applications.	Promote selected plant growth and survival, maintain aesthetics.	Twice annually.	At a minimum, schedule weeding with inspections to coincide with important horticultural cycles (e.g., prior to major weed varieties dispersing seeds).
Fertilization: If necessary apply by hand (see note).	Plant growth and survival.	Determined by inspection.	Installations should be designed to not require fertilization after plant establishment. If fertilization is necessary during plant establishment or for plant health and survivability after establishment, use an encapsulated, slow release fertilizer (excessive fertilization can contribute to increased nutrient loads in the stormwater system and receiving waters).
Irrigate: Use subsurface or drip irrigation.		Determined by inspection and only when absolutely necessary for plant survival.	Surface irrigation systems can promote weed establishment, root development near the drier surface layer of the soil substrate, and increase plant dependence on irrigation. Accordingly, subsurface irrigation methods are preferred. If surface irrigation is the only method available, use drip irrigation to deliver water to the base of the plant.
Remove snow: Use snow plow with skids or rollers to slightly raise blade above gravel surface.	Avoid concentrated sedimentation accumulation.	Determined by inspection/snow depth.	Elevating blades at least one (1) inch above the aggregate surface prevents loss of top course aggregate and damage to plastic grid.
Replace permeable paving material	Maintain infiltration and stormwater storage capability.	Determined by inspection.	If facility is designed, installed and maintained properly permeable paving should last as long as conventional paving.

E. Vegetated Roof Maintenance Schedule

Proper maintenance and operation are essential to ensure that designed performance and benefits continue over the full life cycle of the installation. Each roof garden installation will have specific design, operation and maintenance guidelines provided by the manufacturer and installer. The following guidelines are for extensive roof systems and provide a general set of standards for prolonged roof garden performance.

General maintenance guidelines

- All facility components, including structural components, waterproofing, drainage layers, soil substrate, vegetation, and drains should be inspected for proper operation throughout the life of the roof garden.
- Drain inlets should provide unrestricted stormwater flow from the drainage layer to the roof drain system unless the assembly is specifically designed to impound water as part of an irrigation or stormwater management program.
- The property owner should provide the maintenance and operation plan and inspection schedule.
- Written guidance and/or training for operating and maintaining roof gardens should be provided along with the operation and maintenance agreement to all property owners and tenants.
- All elements of an extensive roof installation should be inspected twice annually.
- The facility owner should keep a maintenance log recording inspection dates, observations, and activities.
- Inspections should be scheduled to coincide with maintenance operations and with important horticultural cycles (e.g., prior to major weed varieties dispersing seeds).

Routine

Activity	Objective	Schedule	Notes
Structural & drainage components			
Clear inlet pipes: Remove soil substrate, vegetation or other debris.	Maintain free drainage of inlet pipes.	Twice annually.	
Inspect drain pipe: Check for cracks settling and proper alignment, and correct and re-compact soils or fill material surrounding pipe, if necessary	Maintain free drainage of inlet pipes.	Twice annually.	
Inspect fire ventilation points for proper operation	Fire and safety.	Twice annually.	
Maintain egress and ingress: Clear routes of obstructions and maintained to design standards	Fire and safety.	Twice annually.	
Insects (see note)			Roof garden design should provide drainage rates that do not allow pooling of water for periods that promote insect larvae development. If standing water is present for extended periods correct drainage problem. Chemical sprays should not be used.

Vegetated Roof Maintenance Schedule (cont.)

Prevent release of contaminants: Identify activities (mechanical systems maintenance, pet access, etc.) that can potentially release pollutants to the roof garden and establish agreements to prevent release.	Water quality protection.	During construction of roof and then as determined by inspection.	Any cause of pollutant release should be corrected as soon as identified and the pollutant removed.
Vegetation and growth medium			
Invasive or nuisance plants: Remove manually and without herbicide applications.	Promote selected plant growth and survival, maintain aesthetics.	Twice annually.	At a minimum, schedule weeding with inspections to coincide with important horticultural cycles (e.g., prior to major weed varieties dispersing seeds).
Removing and replacing dead material: See note.	See note.	Once annually.	Normally, dead plant material will be recycled on the roof; however specific plants or aesthetic considerations may warrant removing and replacing dead material (see manufacturer's recommendations).
Fertilization: If necessary apply by hand (see note).	Plant growth and survival.	Determined by inspection.	Extensive roof gardens should be designed to not require fertilization after plant establishment. If fertilization is necessary during plant establishment or for plant health and survivability after establishment, use an encapsulated, slow release fertilizer (excessive fertilization can contribute to increased nutrient loads in the stormwater system and receiving waters).
Mulching: (see note)			Avoid application of mulch on extensive roof gardens. Mulch should be used only in unusual situations and according to the roof garden provider guidelines. In conventional landscaping mulch enhances moisture retention; however, moisture control on a vegetated roof should be through proper soil/growth media design. Mulch will also increase establishment of weeds.
Irrigate: Use subsurface or drip irrigation.		Determined by inspection and only when absolutely necessary for plant survival.	Surface irrigation systems on extensive roof gardens can promote weed establishment, root development near the drier surface layer of the soil substrate, and increase plant dependence on irrigation. Accordingly, subsurface irrigation methods are preferred. If surface irrigation is the only method available, use drip irrigation to deliver water to the base of the plant.

F. Roof Rainwater Collection System Maintenance Schedule

Maintenance requirements for rainwater collection systems include typical household and system specific procedures. All controls, overflows and cleanouts should be readily accessible and alerts for system problems should be easily visible and audible. The following procedures are operation and maintenance requirements recorded with the deed of homes using roof water harvesting systems in San Juan County, Washington.

Routine

Activity	Objective	Schedule	Notes
Remove debris from roof: Sweep, rake or use leaf blower.	Prevent debris from entering collection and filter system.	Determined by inspection.	
Clean gutters: By hand or use leaf blower.	Prevent debris from entering collection and filter system.	Determined by inspection (generally September, November, January and April). The most critical cleaning is in mid- to late-Spring to flush the pollen deposits from surrounding trees.	Covers for gutters may be appropriate for specific locations, but can make regular cleaning more difficult and will not prevent pollen from entering filter system.
Clean downspout basket screens: Remove debris from screens at top of downspout.	Prevent debris from entering collection and filter system, and clogging of system.	Same as gutters.	
Clean pre-filters	Prevent debris from entering collection and filter system, and clogging of system.	Monthly	
Clean storage tanks of debris: Drain tank and remove debris from bottom of tank.	Prevent contamination.	Determined by inspection.	
Clean particle filters	Prevent contamination.	6 months or determined by pressure drop in system.	
Clean and replace UV filters	Prevent contamination.	Clean every 6 months and replace bulb every 12 months or according to manufacturer's recommendation.	
Chlorinate storage tank: Chlorinate to 0.2ppm-0.5ppm (1/4 cup of household bleach (5.25%) at the rate of 1 cup of bleach to 1000 gallons of stored water)	Prevent contamination.	Quarterly	
Flush household taps: Remove carbon filter and flush until chlorine odor is noticed at taps. Chlorinated water should be left standing in the piping for 30 minutes. Replace the carbon filter.	Prevent contamination.	When storage tanks are cleaned.	

Protection of Low Impact Development IMPs During Construction

Purposes.

Protection of Low impact development (LID) integrated management practices (IMPs) from sediment and compaction requires appropriate construction planning and sequencing to minimize exposure to damaging activities and comprehensive temporary erosion and sediment control. Once installed, LID IMPs are susceptible to sedimentation and compaction until all construction is complete and the project site has been permanently stabilized. Briefing contractors before and during construction, as well as installation of temporary erosion and sediment (TES) controls and protective fencing during all phases of construction is necessary to assure the long-term function of the LID IMPs.

In the event of transitions between construction site management, TES controls and protective fencing shall be installed by the outgoing contractor prior to the transition. A site plan drawing indicating locations of LID IMPs, TES controls and protective fencing shall be provided by the outgoing contractor to the site owner. The site owner shall furnish copies of the site drawing to the incoming contractor. The incoming contractor shall maintain and repair the TES controls as necessary until job completion or subsequent contractor transition. In the event of delays between contractor transitions, it shall be the site owner's responsibility to regularly inspect and repair TES controls. This may be accomplished via contractual agreements with the outgoing contractor.

General Protection Measures.

Storage or staging of construction and landscaping materials and equipment is prohibited on pervious pavements and within vegetated LID IMPs. Pervious pavements, vegetated IMPs, their side slopes and entrance and exit structures shall remain free of all materials and equipment during all phases of construction excluding materials installed for protection purposes.

Access in pervious areas shall be limited or prohibited as follows:

- Vehicular and heavy equipment access over pervious pavement subgrades shall be limited to activities necessary for subgrade preparation and approved by the engineer.
- Vehicular and heavy equipment access over wearing courses is prohibited until pavement is sufficiently cured.
- Vehicular and heavy equipment access through vegetated IMPs is prohibited.
- Pedestrian access into vegetated IMPs shall be limited to necessary activities including subgrade preparation, under-drain, flow entrance and outfall installation and planting operations.
- All other pedestrian access into vegetated IMPs is prohibited unless approved by the Engineer.

Debris, chemicals, sediment or sediment-containing runoff shall not be directed toward pervious pavements. Temporary erosion and sediment controls shall be used to prevent construction or sediment containing runoff from entering vegetated IMPs. Where no practical method to direct sediment laden construction flows away from vegetated BMP's exists, an approved plan for sediment removal, soil rehabilitation, infiltration verification and completion shall be provided by the engineer.

Airborne dust shall not be allowed to deposit or collect on pervious pavements.

In existing vegetated areas, pruning shall be allowed only as necessary for safe equipment operation and as approved by the project arborist, forester, or landscape architect.

Soils in areas outside of planned roads, permanent structures, parking areas, construction envelopes, and vegetated IMPs shall be protected from compaction resulting from heavy equipment and materials storage/staging.

Required Controls.

The following provides a basic set of TESC controls shall be used to protect LID IMPs. Additional controls (e.g. chitoan sand, coagulation techniques and soil polymers) may be necessary depending on site conditions.

1. Temporary berms, ditches, culverts, compost cover, seeding, and sediment ponds.

- a. These facilities and strategies shall be used to manage site runoff and prevent sediment-laden runoff from entering or crossing vegetated IMPs or pervious pavements. Design, construction, installation, and maintenance of berms, ditches, culverts, compost application, seeding and sediment ponds shall be in accordance with local erosion and sediment control regulations or the Department of Ecology Stormwater Management Manual for Western Washington (most recently adopted version), whichever is more stringent.

2. Geotextile fabric and plastic sheet covering.

- a. Following curing, at a minimum pervious pavement shall be covered with geotextile fabric and plastic sheeting to prevent accumulation of particulates and debris. Fabric and sheeting shall be maintained in place using sandbags on ropes with a minimum 10-foot grid spacing in all directions. All seams shall be taped or weighted along the entire seam length. There shall be at least a 12-inch overlap of all seams. If covering is used on a slope that has not been permanently stabilized, the up-slope end shall be secured and buried in a 6-inch deep trench with the soil firmly tamped against the covering. The contractor shall inspect coverings daily for rips and uplift. Patch damaged areas with new covering extending 24-inches beyond the damaged area in all directions and fasten to the base covering by taping or secure with a continuous line of sand bags along all edges. Refasten uplifted areas by doubling the original quantity of fasteners. Contact between covering and the ground should always be maintained. Covering may be removed upon completion of all construction phases and/or approval by the Engineer.

3. Protective Fencing.

- a. Orange construction fence shall be used to delineate areas to be protected and off limits from traffic, storage, staging, and disposal. At a minimum, protected areas include naturally vegetated areas, pervious pavements, vegetated LID IMPs, and general landscaped areas including planter beds, lawns and playfields. Fencing materials, installation, and maintenance shall be in accordance with BMP C103: High Visibility Plastic or Metal Fence, as described in the Stormwater Management Manual for Western Washington, Volume II, or in accordance with local standards, whichever is more stringent. Fencing shall be inspected daily during active construction.

4. Curb Cuts.

- a. Curb cuts designed to channel water into vegetated LID IMPs shall be covered to prevent sediment entry. Place a $\frac{3}{4}$ -inch plywood board to the inside of the curb cut. The board shall extend a minimum of 3-inches to either side of the curb cut, to the

top of the curb cut, and 1-foot below the bottom of the curb cut opening. The bottom of the board shall be secured in place by inserting it between the concrete and soil. The top of the board shall be secured with sand bags placed against the side of the board opposite the curb cut opening. The sand bags shall overlap both ends of the board to limit sediment entry around the edges, and shall be placed along the entire length of the board on the side opposite the curb cut. At a minimum, curb cut covers shall be inspected and repaired as needed after each rainfall event and daily during active construction.

5. Filter Fencing, straw and compost waddles or berms and coir, jute or straw mats.

- a. Filter fencing shall be used at all entry-points around vegetated IMPs, excluding curb cuts, and along the sides of vegetated IMPs where adjacent land area has no slope or slopes toward the BMP. Filter fencing is not necessary if adjacent land areas slope away from the vegetated LID BMP or has been permanently stabilized against erosion AND no upgradient construction activities are planned that may direct sediments toward the BMP. Filter fence materials, installation, and maintenance shall be in accordance with BMP C233: Silt Fence, as described in the Stormwater Management Manual for Western Washington, Volume II, or in accordance with local standards, whichever is more stringent. The following requirements are in addition to BMP C233:
 - i. The geotextile at the bottom of the fence shall be buried in a trench to a minimum depth of 6-inches below ground surface.
 - ii. Excavation for installation of sediment fence within the dripline of trees and other vegetation to be retained shall be approved by the Engineer prior to trenching and shall circumvent critical root zones unless specifically approved by the Engineer.
 - iii. At a minimum, filter fencing shall be inspected after each rainfall event and daily during active construction.

Remedies.

If protection measures fail, or site activities result in damage to LID IMPs, remedies shall be required.

1. Pervious pavement.

- a. De minimus quantities of sediment or particulate that accumulate on pervious pavement may be removed via vacuum sweeping or pressure washing. Visible particulate or sediment that cumulatively cover 10% or less of the pervious surface are considered de minimus.
- b. Accumulations greater than de minimus quantities shall be removed via vacuum sweeping or pressure washing. Maintenance should be verified with field infiltration testing. One field test procedure is as follows:
 - i. Attach one end of a 24-inch cylinder to the pavement using plumber's putty.
 - ii. Have a stop watch ready
 - iii. Pour 5 liters of water into the cylinder and record the length of time the water takes to infiltrate
 - iv. Repeat the test 2 more times and calculate the average
 - v. If the pavement is badly clogged, a better seal may be required. In this case, use a silicon or latex sealant
 - vi. If the tested infiltration capacity is 50% or less of the designed infiltration capacity
 1. Perform additional maintenance and retest the pavement

2. Replace the poorly performing pavement if maintenance procedures cannot restore performance to better than 50% of the engineer's specification.
- c. If the structural integrity of pervious pavements is damaged during construction activities, the pavement shall be removed, replaced, and the new areas retested per engineer's specifications.

2. Vegetated LID IMPs.

- a. If de minimus quantities of sediment accumulate in vegetated LID IMPs, the upper 3-inches of material shall be removed from the area influenced by sediment. De minimus quantity is 1/2-inch or less of sediment accumulated over any portion of the facility. The upper 1/2-inch of material shall include the accumulated sediment plus facility soil or rock at flow entrances or outfall. If more than 1/2 -inch of sediment is observed in the facility, then all sediment plus 6 inches of bioretention soil mix or rock at flow entrances or outfall shall be removed from area influenced by sediment and the project engineer shall verify if the facility meets designed infiltration criteria. Removed soils shall be replaced with bioretention soils equivalent to those defined by BMP T3.70: Bio-Infiltration Swale in the Stormwater Management Manual for Western Washington, Volume IV (most recently adopted version). Vegetation damaged or destroyed by construction or sediment removal activities shall also be replaced with equivalent plant materials.
- b. If soils in vegetated IMPs are compacted during construction activities by heavy equipment or materials storage the soil infiltration rate shall be tested. If compaction has reduced the soil infiltration rate below the rate used for facility design, the full LID BMP soil profile shall be replaced. Replacement soils shall be installed following original project design requirements and specifications. The soil infiltration rate shall be verified following installation.



Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices



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FOREWORD

One of the most exciting new trends in water quality management today is the movement by many cities, counties, states, and private-sector developers toward the increased use of Low Impact Development (LID) to help protect and restore water quality. LID comprises a set of approaches and practices that are designed to reduce runoff of water and pollutants from the site at which they are generated. By means of infiltration, evapotranspiration, and reuse of rainwater, LID techniques manage water and water pollutants at the source and thereby prevent or reduce the impact of development on rivers, streams, lakes, coastal waters, and ground water.

Although the increase in application of these practices is growing rapidly, data regarding both the effectiveness of these practices and their costs remain limited. This document is focused on the latter issue, and the news is good. In the vast majority of cases, the U.S. Environmental Protection Agency (EPA) has found that implementing well-chosen LID practices saves money for developers, property owners, and communities while protecting and restoring water quality.

While this study focuses on the cost reductions and cost savings that are achievable through the use of LID practices, it is also the case that communities can experience many amenities and associated economic benefits that go beyond cost savings. These include enhanced property values, improved habitat, aesthetic amenities, and improved quality of life. This study does not monetize and consider these values in performing the cost calculations, but these economic benefits are real and significant. For that reason, EPA has included a discussion of these economic benefits in this document and provided references for interested readers to learn more about them.

Readers interested in increasing their knowledge about LID and Green Infrastructure, which encompasses LID along with other aspects of green development, should see www.epa.gov/npdes/greeninfrastructure and www.epa.gov/nps/lid. It is EPA's hope that as professionals and citizens continue to become more knowledgeable about the effectiveness and costs of LID, the use of LID practices will continue to increase at a rapid pace.

EXECUTIVE SUMMARY

This report summarizes 17 case studies of developments that include Low Impact Development (LID) practices and concludes that applying LID techniques can reduce project costs and improve environmental performance. In most cases, LID practices were shown to be both fiscally and environmentally beneficial to communities. In a few cases, LID project costs were higher than those for conventional stormwater management practices. However, in the vast majority of cases, significant savings were realized due to reduced costs for site grading and preparation, stormwater infrastructure, site paving, and landscaping. Total capital cost savings ranged from 15 to 80 percent when LID methods were used, with a few exceptions in which LID project costs were higher than conventional stormwater management costs.

EPA has identified several additional areas that will require further study. First, in all cases, there were benefits that this study did not monetize and did not factor into the project's bottom line. These benefits include improved aesthetics, expanded recreational opportunities, increased property values due to the desirability of the lots and their proximity to open space, increased total number of units developed, increased marketing potential, and faster sales. Second, more research is also needed to quantify the environmental benefits that can be achieved through the use of LID techniques and the costs that can be avoided. Examples of environmental benefits include reduced runoff volumes and pollutant loadings to downstream waters, and reduced incidences of combined sewer overflows. Finally, more research is needed to monetize the cost reductions that can be achieved through improved environmental performance, reductions in long-term operation and maintenance costs, and/or reductions in the life cycle costs of replacing or rehabilitating infrastructure.

INTRODUCTION

BACKGROUND

Most stormwater runoff is the result of the man-made hydrologic modifications that normally accompany development. The addition of impervious surfaces, soil compaction, and tree and vegetation removal result in alterations to the movement of water through the environment. As interception, evapotranspiration, and infiltration are reduced and precipitation is converted to overland flow, these modifications affect not only the characteristics of the developed site but also the watershed in which the development is located. Stormwater has been identified as one of the leading sources of pollution for all waterbody types in the United States. Furthermore, the impacts of stormwater pollution are not static; they usually increase with more development and urbanization.

Extensive development in the United States is a relatively recent phenomenon. For the past two decades, the rate of land development across the country has been twice the rate of population growth. Approximately 25 million acres were developed between 1982 and 1997, resulting in a 34 percent increase in the amount of developed land with only a 15 percent increase in population.^{1,2} The 25 million acres developed during this 15-year period represent nearly 25 percent of the total amount of developed land in the contiguous states. The U.S. population is expected to increase by 22 percent from 2000 to 2025. If recent development trends continue, an additional 68 million acres of land will be developed during this 25-year period.³

Water quality protection strategies are often implemented at three scales: the region or large watershed area, the community or neighborhood, and the site or block. Different stormwater approaches are used at different scales to afford the greatest degree of protection to waterbodies because the influences of pollution are often found at all three scales. For example, decisions about where and how to grow are the first and perhaps most important decisions related to water quality. Growth and development can give a community the resources needed to revitalize a downtown, refurbish a main street, build new schools, and develop vibrant places to live, work, shop, and play. The environmental impacts of development, however, can pose challenges for communities striving to protect their natural resources. Development that uses land efficiently and protects undisturbed natural lands allows a community to grow and still protect its water resources.

Strategies related to these broad growth and development issues are often implemented at the regional or watershed scale. Once municipalities have determined where to grow and where to preserve, various stormwater management techniques are applied at the neighborhood or community level. These measures, such as road width requirements, often transcend specific development sites and can be applied throughout a neighborhood. Finally, site-specific stormwater strategies, such as rain gardens and infiltration areas, are incorporated within a particular development. Of course, some stormwater management strategies can be applied at several scales. For example, opportunities to maximize infiltration can occur at the neighborhood and site levels.

Many smart growth approaches can decrease the overall amount of impervious cover associated with a development's footprint. These approaches include directing development to already degraded land; using narrower roads; designing smaller parking lots; integrating retail, commercial, and residential uses; and designing more compact residential lots. These development approaches, combined with other techniques aimed at reducing the impact of development, can offer communities superior stormwater management.

Stormwater management programs have struggled to provide adequate abatement and treatment of stormwater at the current levels of development. Future development will create even greater challenges for maintaining and improving water quality in the nation's waterbodies. The past few decades of stormwater management have resulted in the current convention of control-and-treatment strategies. They are largely engineered, end-of-pipe practices that have been focused on controlling peak flow rate and suspended solids concentrations. Conventional practices, however, fail to address the widespread and cumulative hydrologic modifications within the watershed that increase stormwater volumes and runoff rates and cause excessive erosion and stream channel degradation. Existing practices also fail to adequately treat for other pollutants of concern, such as nutrients, pathogens, and metals.

LOW IMPACT DEVELOPMENT

Low Impact Development (LID)⁴ is a stormwater management strategy that has been adopted in many localities across the country in the past several years. It is a stormwater management approach and set of practices that can be used to reduce runoff and pollutant loadings by managing the runoff as close to its source(s) as possible. A set or system of small-scale practices, linked together on the site, is often used. LID approaches can be used to reduce the impacts of development and redevelopment activities on water resources. In the case of new development, LID is typically used to achieve or pursue the goal of maintaining or closely replicating the predevelopment hydrology of the site. In areas where development has already occurred, LID can be used as a retrofit practice to reduce runoff volumes, pollutant loadings, and the overall impacts of existing development on the affected receiving waters.

In general, implementing integrated LID practices can result in enhanced environmental performance while at the same time reducing development costs when compared to traditional stormwater management approaches. LID techniques promote the use of natural systems, which can effectively remove nutrients, pathogens, and metals from stormwater. Cost savings are typically seen in reduced infrastructure because the total volume of runoff to be managed is minimized through infiltration and evapotranspiration. By working to mimic the natural water cycle, LID practices protect downstream resources from adverse pollutant and hydrologic impacts that can degrade stream channels and harm aquatic life.

It is important to note that typical, real-world LID designs usually incorporate more than one type of practice or technique to provide integrated treatment of runoff from a site. For example, in lieu of a treatment pond serving a new subdivision, planners might incorporate a bioretention area in each yard, disconnect downspouts from driveway surfaces, remove curbs, and install grassed swales in common areas. Integrating small

practices throughout a site instead of using extended detention wet ponds to control runoff from a subdivision is the basis of the LID approach.

When conducting cost analyses of these practices, examples of projects where actual practice-by-practice costs were considered separately were found to be rare because material and labor costs are typically calculated for an entire site rather than for each element within a larger system. Similarly, it is difficult to calculate the economic benefits of individual LID practices on the basis of their effectiveness in reducing runoff volume and rates or in treating pollutants targeted for best management practice (BMP) performance monitoring.

The following is a summary of the different categories of LID practices, including a brief description and examples of each type of practice.

Conservation designs can be used to minimize the generation of runoff by preserving open space. Such designs can reduce the amount of impervious surface, which can cause increased runoff volumes. Open space can also be used to treat the increased runoff from the built environment through infiltration or evapotranspiration. For example, developers can use conservation designs to preserve important features on the site such as wetland and riparian areas, forested tracts, and areas of porous soils.

Development plans that outline the smallest site disturbance area can minimize the stripping of topsoil and compaction of subsoil that result from grading and equipment use. By preserving natural areas and not clearing and grading the entire site for housing lots, less total runoff is generated on the development parcel. Such simplistic, nonstructural methods can reduce the need to build large structural runoff controls like retention ponds and stormwater conveyance systems and thereby decrease the overall infrastructure costs of the project. Reducing the total area of impervious surface by limiting road widths, parking area, and sidewalks can also reduce the volume of runoff that must be treated. Residential developments that incorporate conservation design principles also can benefit residents and their quality of life due to increased access and proximity to communal open space, a greater sense of community, and expanded recreational opportunities.

Examples of Conservation Design

- Cluster development
- Open space preservation
- Reduced pavement widths (streets, sidewalks)
- Shared driveways
- Reduced setbacks (shorter driveways)
- Site fingerprinting during construction

Infiltration practices are engineered structures or landscape features designed to capture and infiltrate runoff. They can be used to reduce both the volume of runoff discharged from the site and the infrastructure needed to convey, treat, or control runoff. Infiltration practices can also be used to recharge ground water. This benefit is especially important in areas where maintaining drinking water supplies and stream baseflow is of special concern because of limited precipitation or a high ratio of withdrawal to recharge rates. Infiltration of runoff can also help to maintain stream temperatures because the infiltrated water that moves laterally to replenish stream baseflow typically has a lower temperature than overland flows, which might be subject

Examples of Infiltration Practices

- Infiltration basins and trenches
- Porous pavement
- Disconnected downspouts
- Rain gardens and other vegetated treatment systems

to solar radiation. Another advantage of infiltration practices is that they can be integrated into landscape features in a site-dispersed manner. This feature can result in aesthetic benefits and, in some cases, recreational opportunities; for example, some infiltration areas can be used as playing fields during dry periods.

Runoff storage practices. Impervious surfaces are a central part of the built environment, but runoff from such surfaces can be captured and stored for reuse or gradually infiltrated, evaporated, or used to irrigate plants. Using runoff storage practices has several benefits. They can reduce the volume of runoff discharged to surface waters, lower the peak flow hydrograph to protect streams from the erosive forces of high flows, irrigate landscaping, and provide aesthetic benefits such as landscape islands, tree boxes, and rain gardens. Designers can take advantage of the void space beneath paved areas like parking lots and sidewalks to provide additional storage. For example, underground vaults can be used to store runoff in both urban and rural areas.

Examples of Runoff Storage Practices

- Parking lot, street, and sidewalk storage
- Rain barrels and cisterns
- Depressional storage in landscape islands and in tree, shrub, or turf depressions
- Green roofs

Runoff conveyance practices. Large storm events can make it difficult to retain all the runoff generated on-site by using infiltration and storage practices. In these situations, conveyance systems are typically used to route excess runoff through and off the site. In LID designs, conveyance systems can be used to slow flow velocities, lengthen the runoff time of concentration, and delay peak flows that are discharged off-site. LID conveyance practices can be used as an alternative to curb-and-gutter systems, and from a water quality perspective they have advantages over conventional approaches designed to rapidly convey runoff off-site and alleviate on-site flooding. LID conveyance practices often have rough surfaces, which slow runoff and increase evaporation and settling of solids. They are typically permeable and vegetated, which promotes infiltration, filtration, and some biological uptake of pollutants. LID conveyance practices also can perform functions similar to those of conventional curbs, channels, and gutters. For example, they can be used to reduce flooding around structures by routing runoff to landscaped areas for treatment, infiltration, and evapotranspiration.

Examples of Runoff Conveyance Practices

- Eliminating curbs and gutters
- Creating grassed swales and grass-lined channels
- Roughening surfaces
- Creating long flow paths over landscaped areas
- Installing smaller culverts, pipes, and inlets
- Creating terraces and check dams

Filtration practices are used to treat runoff by filtering it through media that are designed to capture pollutants through the processes of physical filtration of solids and/or cation exchange of dissolved pollutants. Filtration practices offer many of the same benefits as infiltration, such as reductions in the volume of runoff transported off-site, ground water recharge, increased stream baseflow, and reductions in thermal impacts to receiving waters. Filtration practices also have the added advantage of providing increased pollutant removal benefits. Although pollutant build-up and removal may be of concern, pollutants are typically captured in the upper soil horizon and can be removed by replacing the topsoil.

Examples of Filtration Practices

- Bioretention/rain gardens
- Vegetated swales
- Vegetated filter strips/buffers

Low impact landscaping. Selection and distribution of plants must be carefully planned when designing a functional landscape. Aesthetics are a primary concern, but it is also important to consider long-term maintenance goals to reduce inputs of labor, water, and chemicals. Properly preparing soils and selecting species adapted to the microclimates of a site greatly increases the success of plant establishment and growth, thereby stabilizing soils and allowing for biological uptake of pollutants. Dense, healthy plant growth offers such benefits as pest resistance (reducing the need for pesticides) and improved soil infiltration from root growth. Low impact landscaping can thus reduce impervious surfaces, improve infiltration potential, and improve the aesthetic quality of the site.

Examples of Low Impact Landscaping

- Planting native, drought-tolerant plants
- Converting turf areas to shrubs and trees
- Reforestation
- Encouraging longer grass length
- Planting wildflower meadows rather than turf along medians and in open space
- Amending soil to improve infiltration

EVALUATIONS OF BENEFITS AND COSTS

To date, the focus of traditional stormwater management programs has been concentrated largely on structural engineering solutions to manage the hydraulic consequences of the increased runoff that results from development. Because of this emphasis, stormwater management has been considered primarily an engineering endeavor. Economic analyses regarding the selection of solutions that are not entirely based on pipes and ponds have not been a significant factor in management decisions. Where costs have been considered, the focus has been primarily on determining capital costs for conventional infrastructure, as well as operation and maintenance costs in dollars per square foot or dollars per pound of pollutant removed.

Little attention has been given to the benefits that can be achieved through implementing LID practices. For example, communities rarely attempt to quantify and monetize the pollution prevention benefits and avoided treatment costs that might accrue from the use of conservation designs or LID techniques. To be more specific, the benefits of using LID practices to decrease the need for combined sewer overflow (CSO) storage and conveyance systems should be factored into the economic analyses. One of the major factors preventing LID practices from receiving equal consideration in the design or selection process is the difficulty of monetizing the environmental benefits of these practices. Without good data and relative certainty that these alternatives will work and not increase risk or cost, current standards of practice are difficult to change.

This report is an effort to compare the projected or known costs of LID practices with those of conventional development approaches. At this point, monetizing the economic and environmental benefits of LID strategies is much more difficult than monetizing traditional infrastructure costs or changes in property values due to improvements in existing utilities or transportation systems. Systems of practices must be analyzed to determine net performance and monetary benefits based on the capacity of the systems to both treat for pollutants and reduce impacts through pollution prevention. For example, benefits might come in the form of reduced stream channel degradation, avoided stream restoration costs, or reduced drinking water treatment costs.

One of the chief impediments to getting useful economic data to promote more widespread use of LID techniques is the lack of a uniform baseline with which to compare the costs and benefits of LID practices against the costs of conventional stormwater treatment and control. Analyzing benefits is further complicated in cases where the environmental performance of the conservation design or LID system exceeds that of the conventional runoff management system, because such benefits are not easily monetized. The discussion below is intended to provide a general discussion of the range of economic benefits that may be provided by LID practices in a range of appropriate circumstances.

OVERVIEW OF BENEFITS

The following is a brief discussion of some of the actual and assumed benefits of LID practices. Note that environmental and ancillary benefits typically are not measured as part of development projects, nor are they measured as part of pilot or demonstration projects, because they can be difficult to isolate and quantify. Many of the benefits described below are assumed on the basis of limited studies and anecdotal evidence.

The following discussion is organized into three categories: (1) environmental benefits, which include reductions in pollutants, protection of downstream water resources, ground water recharge, reductions in pollutant treatment costs, reductions in the frequency and severity of CSOs, and habitat improvements; (2) land value benefits, which include reductions in downstream flooding and property damage, increases in real estate value, increased parcel lot yield, increased aesthetic value, and improvement of quality of life by providing open space for recreation; and (3) compliance incentives.

Environmental Benefits

Pollution abatement. LID practices can reduce both the volume of runoff and the pollutant loadings discharged into receiving waters. LID practices result in pollutant removal through settling, filtration, adsorption, and biological uptake. Reductions in pollutant loadings to receiving waters, in turn, can improve habitat for aquatic and terrestrial wildlife and enhance recreational uses. Reducing pollutant loadings can also decrease stormwater and drinking water treatment costs by decreasing the need for regional stormwater management systems and expansions in drinking water treatment systems.

Protection of downstream water resources. The use of LID practices can help to prevent or reduce hydrologic impacts on receiving waters, reduce stream channel degradation from erosion and sedimentation, improve water quality, increase water supply, and enhance the recreational and aesthetic value of our natural resources. LID practices can be used to protect water resources that are downstream in the watershed. Other potential benefits include reduced incidence of illness from contact recreation activities such as swimming and wading, more robust and safer seafood supplies, and reduced medical treatment costs.

Ground water recharge. LID practices also can be used to infiltrate runoff to recharge ground water. Growing water shortages nationwide increasingly indicate the need for water resource management strategies designed to integrate stormwater, drinking water, and wastewater programs to maximize benefits and minimize costs. Development pressures typically result in increases in the amount of impervious surface and volume of runoff. Infiltration practices can be used to replenish ground water and increase stream baseflow. Adequate baseflow to streams during dry weather is important because low ground water levels can lead to greater fluctuations in stream depth, flows, and temperatures, all of which can be detrimental to aquatic life.

Water quality improvements/reduced treatment costs. It is almost always less expensive to keep water clean than it is to clean it up. The Trust for Public Land⁵ noted Atlanta's tree cover has saved more than \$883 million by preventing the need for stormwater retention facilities. A study of 27 water suppliers conducted by the Trust for Public Land and the American Water Works Association⁶ found a direct relationship between forest cover in a watershed and water supply treatment costs. In other words, communities with higher percentages of forest cover had lower treatment costs. According to the study, approximately 50 to 55 percent of the variation in treatment costs can be explained by the percentage of forest cover in the source area. The researchers also found that for every 10 percent increase in forest cover in the source area, treatment and chemical costs decreased approximately 20 percent, up to about 60 percent forest cover.

Reduced incidence of CSOs. Many municipalities have problems with CSOs, especially in areas with aging infrastructure. Combined sewer systems discharge sanitary wastewater during storm events. LID techniques, by retaining and infiltrating runoff, reduce the frequency and amount of CSO discharges to receiving waters. Past management efforts typically have been concentrated on hard engineering approaches focused on treating the total volume of sanitary waste together with the runoff that is discharged to the combined system. Recently, communities like Portland (Oregon), Chicago, and Detroit have been experimenting with watershed approaches aimed at reducing the total volume of runoff generated that must be handled by the combined system. LID techniques have been the primary method with which they have experimented to reduce runoff. A Hudson Riverkeeper report concluded, based on a detailed technical analysis, that New York City could reduce its CSO's more cost-effectively with LID practices than with conventional, hard infrastructure CSO storage practices.⁷

Habitat improvements. Innovative stormwater management techniques like LID or conservation design can be used to improve natural resources and wildlife habitat, maintain or increase land value, or avoid expensive mitigation costs.

Land Value and Quality of Life Benefits

Reduced downstream flooding and property damage. LID practices can be used to reduce downstream flooding through the reduction of peak flows and the total amount or volume of runoff. Flood prevention reduces property damage and can reduce the initial capital costs and the operation and maintenance costs of stormwater infrastructure. Strategies designed to manage runoff on-site or as close as possible to its point of generation can reduce erosion and sediment transport as well as reduce flooding and downstream erosion. As a result, the costs for cleanups and streambank restoration can be reduced or avoided altogether. The use of LID techniques also can help protect or restore floodplains, which can be used as park space or wildlife habitat.⁸

Real estate value/property tax revenue. Homeowners and property owners are willing to pay a premium to be located next to or near aesthetically pleasing amenities like water features, open space, and trails. Some stormwater treatment systems can be beneficial to developers because they can serve as a "water" feature or other visual or recreational amenity that can be used to market the property. These designs should be visually attractive and safe for the residents and should be considered an integral part of planning the development. Various LID projects and smart growth studies have shown that people are willing to pay more for clustered homes than conventionally designed subdivisions. Clustered housing with open space appreciated at a higher rate than conventionally designed subdivisions. EPA's *Economic Benefits of Runoff Controls*⁹ describes numerous examples where developers and subsequent homeowners have received premiums for proximity to attractive stormwater management practices.

Lot yield. LID practices typically do not require the large, contiguous areas of land that are usually necessary when traditional stormwater controls like ponds are used. In cases where LID practices are incorporated on individual house lots and along roadsides as part of the landscaping, land that would normally be dedicated for a stormwater pond or other large structural control can be developed with additional housing lots.

Aesthetic value. LID techniques are usually attractive features because landscaping is an integral part of the designs. Designs that enhance a property's aesthetics using trees, shrubs, and flowering plants that complement other landscaping features can be selected. The use of these designs may increase property values or result in faster sale of the property due to the perceived value of the "extra" landscaping.

Public spaces/quality of life/public participation. Placing water quality practices on individual lots provides opportunities to involve homeowners in stormwater management and enhances public awareness of water quality issues. An American Lives, Inc., real estate study found that 77.7 percent of potential homeowners rated natural open space as "essential" or "very important" in planned communities.¹⁰

Compliance Incentives

Regulatory compliance credits. Many states recognize the positive benefits LID techniques offer, such as reduced wetland impacts. As a result, they might offer regulatory compliance credits, streamlined or simpler permit processes, and other incentives similar to those offered for other green practices. For example, in Maryland the volume required for the permanent pool of a wet pond can be reduced if rooftop runoff is infiltrated on-site using LID practices. This procedure allows rooftop area to be subtracted from the total impervious area, thereby reducing the required size of the permanent pool. In addition, a LID project can have less of an environmental impact than a conventional project, thus requiring smaller impact fees.

COST CONSIDERATIONS

Traditional approaches to stormwater management involve conveying runoff off-site to receiving waters, to a combined sewer system, or to a regional facility that treats runoff from multiple sites. These designs typically include hard infrastructure, such as curbs, gutters, and piping. LID-based designs, in contrast, are designed to use natural drainage features or engineered swales and vegetated contours for runoff conveyance and treatment. In terms of costs, LID techniques like conservation design can reduce the amount of materials needed for paving roads and driveways and for installing curbs and gutters. Conservation designs can be used to reduce the total amount of impervious surface, which results in reduced road and driveway lengths and reduced costs. Other LID techniques, such as grassed swales, can be used to infiltrate roadway runoff and eliminate or reduce the need for curbs and gutters, thereby reducing infrastructure costs. Also, by infiltrating or evaporating runoff, LID techniques can reduce the size and cost of flood-control structures. Note that more research is needed to determine the optimal combination of LID techniques and detention practices for flood control.

It must be stated that the use of LID techniques might not always result in lower project costs. The costs might be higher because of the costs of plant material, site preparation, soil amendments, underdrains and connections to municipal stormwater systems, and increased project management.

Another factor to consider when comparing costs between traditional and LID designs is the amount of land required to implement a management practice. Land must be set aside for both traditional stormwater management practices and LID practices, but the former require the use of land *in addition to* individual lots and other community areas, whereas bioretention areas and swales can be incorporated into the landscaping of yards, in rights-

of-way along roadsides, and in or adjacent to parking lots. The land that would have been set aside for ponds or wetlands can in many cases be used for additional housing units, yielding greater profits.

Differences in maintenance requirements should also be considered when comparing costs. According to a 1999 EPA report, maintenance costs for retention basins and constructed wetlands were estimated at 3 to 6 percent of construction costs, whereas maintenance costs for swales and bioretention practices were estimated to be 5 to 7 percent of construction costs.¹¹ However, much of the maintenance for bioretention areas and swales can be accomplished as part of routine landscape maintenance and does not require specialized equipment. Wetland and pond maintenance, on the other hand, involves heavy equipment to remove accumulated sediment, oils, trash, and vegetation in forebays and open ponds.

Finally, in some circumstances LID practices can offset the costs associated with regulatory requirements for stormwater control. In urban redevelopment projects where land is not likely to be available for large stormwater management practices, developers can employ site-dispersed BMPs in sidewalk areas, in courtyards, on rooftops, in parking lots, and in other small outdoor spaces, thereby avoiding the fees that some municipalities charge when stormwater mitigation requirements cannot otherwise be met. In addition, stormwater utilities often provide credits for installing runoff management practices such as LID practices.¹²

CASE STUDIES

The case studies presented below are not an exhaustive list of LID projects nationwide. These examples were selected on the basis of the quantity and quality of economic data, quantifiable impacts, and types of LID practices used. Economic data are available for many other LID installations, but those installations often cannot be compared with conventional designs because of the unique nature of the design or the pilot status of the project. Table 1 presents a summary of the LID practices employed in each case study.

Table 1. Summary of LID Practices Employed in the Case Studies

Name	LID Techniques							
	Biore-tention	Cluster Building	Reduced Impervious Area	Swales	Permeable Pavement	Vegetated Landscaping	Wetlands	Green Roofs
2 nd Avenue SEA Street	✓		✓	✓				
Auburn Hills	✓		✓	✓		✓	✓	
Bellingham Parking Lot Retrofits	✓							
Central Park Commercial Redesigns	✓			✓				
Crown Street	✓		✓	✓				
Gap Creek			✓			✓		
Garden Valley	✓	✓		✓	✓		✓	
Kensington Estates		✓	✓		✓	✓	✓	
Laurel Springs	✓	✓	✓	✓				
Mill Creek		✓	✓	✓				
Poplar Street Apartments	✓			✓			✓	
Portland Downspout Disconnection*			✓					
Prairie Crossing	✓		✓	✓		✓		
Prairie Glen	✓	✓	✓	✓		✓	✓	
Somerset	✓			✓				
Tellabs Corporate Campus	✓			✓		✓	✓	
Toronto Green Roofs								✓

*Although impervious area stays the same, the disconnection program reduces directly connected impervious area.

The case studies contain an analysis of development costs, which are summarized in Table 2. Note that some case study results do not lend themselves well to a traditional vs.

LID cost comparison and therefore are not included in Table 2 (as noted). *Conventional development cost* refers to costs incurred or estimated for a traditional stormwater management approach, whereas *LID cost* refers to costs incurred or estimated for using LID practices. *Cost difference* is the difference between the conventional development cost and the LID cost. *Percent difference* is the cost savings relative to the conventional development cost.

Table 2. Summary of Cost Comparisons Between Conventional and LID Approaches^a

Project	Conventional Development Cost	LID Cost	Cost Difference ^b	Percent Difference ^b
2 nd Avenue SEA Street	\$868,803	\$651,548	\$217,255	25%
Auburn Hills	\$2,360,385	\$1,598,989	\$761,396	32%
Bellingham City Hall	\$27,600	\$5,600	\$22,000	80%
Bellingham Bloedel Donovan Park	\$52,800	\$12,800	\$40,000	76%
Gap Creek	\$4,620,600	\$3,942,100	\$678,500	15%
Garden Valley	\$324,400	\$260,700	\$63,700	20%
Kensington Estates	\$765,700	\$1,502,900	-\$737,200	-96%
Laurel Springs	\$1,654,021	\$1,149,552	\$504,469	30%
Mill Creek ^c	\$12,510	\$9,099	\$3,411	27%
Prairie Glen	\$1,004,848	\$599,536	\$405,312	40%
Somerset	\$2,456,843	\$1,671,461	\$785,382	32%
Tellabs Corporate Campus	\$3,162,160	\$2,700,650	\$461,510	15%

^a The Central Park Commercial Redesigns, Crown Street, Poplar Street Apartments, Prairie Crossing, Portland Downspout Disconnection, and Toronto Green Roofs study results do not lend themselves to display in the format of this table.

^b Negative values denote increased cost for the LID design over conventional development costs.

^c Mill Creek costs are reported on a per-lot basis.

2ND AVENUE SEA STREET, SEATTLE, WASHINGTON

The 2nd Avenue Street Edge Alternative (SEA) Street project was a pilot project undertaken by Seattle Public Utilities to redesign an entire 660-foot block with a number of LID techniques. The goals were to reduce stormwater runoff and to provide a more “livable” community. Throughout the design and construction process, Seattle Public Utilities worked collaboratively with street residents to develop the final street design.¹³



The design reduced imperviousness, included retrofits of bioswales to treat and manage stormwater, and added 100 evergreen trees and 1,100 shrubs.¹⁴ Conventional curbs and gutters were replaced with bioswales in the rights-of-way on both sides of the street, and the street width was reduced from 25 feet to 14 feet. The final constructed design reduced imperviousness by more than 18 percent. An estimate for the final total project cost was \$651,548. A significant amount of community outreach was involved, which raised the level of community acceptance. Community input is important for any project, but because this was a pilot study, much more was spent on communication and redesign than what would be spent for a typical project.

The costs for the LID retrofit were compared with the estimated costs of a conventional street retrofit (Table 3). Managing stormwater with LID techniques resulted in a cost savings of 29 percent. Also, the reduction in street width and sidewalks reduced paving costs by 49 percent.

Table 3. Cost Comparison for 2nd Avenue SEA Street ¹⁵

Item	Conventional Development Cost	SEA Street Cost	Cost Savings*	Percent Savings*	Percent of Total Savings*
Site preparation	\$65,084	\$88,173	-\$23,089	-35%	-11%
Stormwater management	\$372,988	\$264,212	\$108,776	29%	50%
Site paving and sidewalks	\$287,646	\$147,368	\$140,278	49%	65%
Landscaping	\$78,729	\$113,034	-\$34,305	-44%	-16%
Misc. (mobilization, etc.)	\$64,356	\$38,761	\$25,595	40%	12%
Total	\$868,803	\$651,548	\$217,255	--	--

* Negative values denote increased cost for the LID design over conventional development costs.

The avoided cost for stormwater infrastructure and reduced cost for site paving accounted for much of the overall cost savings. The nature of the design, which included extensive use of bioswales and vegetation, contributed to the increased cost for site preparation and landscaping. Several other SEA Street projects have been completed or are under way, and cost evaluations are expected to be favorable.

For this site, the environmental performance has been even more significant than the cost savings. Hydrologic monitoring of the project indicates a 99 percent reduction in total potential surface runoff, and runoff has not been recorded at the site since December 2002, a period that included the highest-ever 24-hour recorded rainfall at Seattle-Tacoma Airport.¹⁶ The site is retaining more than the original design estimate of 0.75 inch of rain. A modeling analysis indicates that if a conventional curb-and-gutter system had been installed along 2nd Avenue instead of the SEA Street design, 98 times more stormwater would have been discharged from the site.¹⁷

AUBURN HILLS SUBDIVISION, SOUTHWESTERN WISCONSIN

Auburn Hills in southwestern Wisconsin is a residential subdivision developed with conservation design principles. Forty percent of the site is preserved as open space; this open space includes wetlands, green space and natural plantings, and walking trails. The subdivision was designed to

include open swales and bioretention for stormwater management. To determine potential savings from using conservation design, the site construction costs were compared with the estimated cost of building the site as a conventional subdivision.¹⁸ Reduced stormwater management costs accounted for approximately 56 percent of the total cost savings. A cost comparison is provided in Table 4. Other savings not shown in Table 4 were realized as a result of reduced sanitary sewer, water distribution, and utility construction costs.



Table 4. Cost Comparison for Auburn Hills Subdivision¹⁹

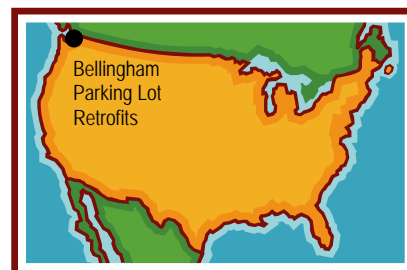
Item	Conventional Development Cost	Auburn Hills LID Cost	Cost Savings*	Percent Savings*	Percent of Total Savings*
Site preparation	\$699,250	\$533,250	\$166,000	24%	22%
Stormwater management	\$664,276	\$241,497	\$422,779	64%	56%
Site paving and sidewalks	\$771,859	\$584,242	\$187,617	24%	25%
Landscaping	\$225,000	\$240,000	-\$15,000	-7%	-2%
Total	\$2,360,385	\$1,598,989	\$761,396	—	—

* Negative values denote increased cost for the LID design over conventional development costs.

The clustered design used in the development protected open space and reduced clearing and grading costs. Costs for paving and sidewalks were also decreased because the cluster design reduced street length and width. Stormwater savings were realized primarily through the use of vegetated swales and bioswales. These LID practices provided stormwater conveyance and treatment and also lowered the cost of conventional stormwater infrastructure. The increase in landscaping costs resulted from additional open space present on-site compared to a conventional design, as well as increased street sweeping. Overall, the subdivision's conservation design retained more natural open space for the benefit and use of the homeowners and aided stormwater management by preserving some of the site's natural hydrology.²⁰

BELLINGHAM, WASHINGTON, PARKING LOT RETROFITS

The City of Bellingham, Washington, retrofitted two parking lots—one at City Hall and the other at Bloedel Donovan Park—with rain gardens in lieu of installing underground vaults to manage stormwater.²¹ At City Hall, 3 parking spaces out of a total of 60 were used for the rain garden installation. The Bloedel Donovan Park retrofit involved converting to a rain garden a 550-square-foot area near a catch basin. Both installations required excavation, geotextile fabric, drain rock, soil amendments, and native plants. Flows were directed to the rain gardens by curbs. An overflow system was installed to accommodate higher flows during heavy rains.



The City compared actual rain garden costs to estimates for conventional underground vaults based on construction costs for similar projects in the area (\$12.00 per cubic foot of storage). Rain garden costs included labor, vehicle use/rental, and materials. Table 5 shows that the City Hall rain garden saved the City \$22,000, or 80 percent, over the underground vault option; the Bloedel Donovan Park installation saved \$40,000, or 76 percent.

Table 5. Cost Comparison for Bellingham's Parking Lot Rain Garden Retrofits²²

Project	Conventional Vault Cost	Rain Garden Cost	Cost Savings	Percent Savings
City Hall	\$27,600	\$5,600	\$22,000	80%
Bloedel Donovan Park	\$52,800	\$12,800	\$40,000	76%

CENTRAL PARK COMMERCIAL REDESIGNS, FREDERICKSBURG, VA (A MODELING STUDY)

The Friends of the Rappahannock undertook a cost analysis involving the redesign of site plans for several stores in a large commercial development in the Fredericksburg, Virginia, area called Central Park.^{23,24} Table 6 contains a side-by-side analysis of the cost additions and reductions for each site for scenarios where LID practices (bioretention areas and swales) were incorporated into the existing, traditional site designs. In five of the six examples, the costs for the LID redesigns were higher than those for the original designs, although they never exceeded \$10,000, or 10 percent of the project. One example yielded a \$5,694 savings. The fact that these projected costs for LID were comparable to the costs for traditional designs convinced the developer to begin incorporating LID practices into future design projects.²⁵



Table 6. Site Information and Cost Additions/Reductions Using LID Versus Traditional Designs

Name	Total BMP Area (ft ²)	Total Impervious Area Treated (ft ²)	Percent of Impervious Area Treated	Cost Additions ^a	Cost Reductions ^b	Change in Cost After Redesign
Breezewood Station Alternative 1	4,800	64,165	98.4%	\$36,696	\$34,785	+ \$1,911
Breezewood Station Alternative 2	3,500	38,775	59.5%	\$24,449	\$21,060	+ \$3,389
Olive Garden	1,780	31,900	59.1%	\$14,885	\$11,065	+ \$3,790
Kohl's, Best Buy, & Office Depot	14,400	354,238	56.3%	\$89,433	\$80,380	+ \$9,053
First Virginia Bank	1,310	20,994	97.7%	\$6,777	\$1,148	+ \$5,629
Chick-Fil-A ^c	1,326	28,908	82.2%	\$6,846	\$12,540	- \$5,694

^a Additional costs for curb, curb blocks, storm piping, inlets, underdrains, soil, mulch, and vegetation as a result of the redesign.

^b Reduced cost for curb, storm piping, roof drain piping, and inlets as a result of the redesign.

^c Cost reduction value includes the cost of a Stormceptor unit that is not needed as part of the redesign.

CROWN STREET, VANCOUVER, BRITISH COLUMBIA

In 1995 the Vancouver City Council adopted a Greenways program that is focused on introducing pedestrian-friendly green space into the City to connect trails, environmental areas, and urban space. As a part of this program, the City has adopted strategies to manage stormwater runoff from roadways. Two initiatives are discussed here.

The Crown Street redevelopment project, completed in 2005, retrofitted a 1,100-foot block of traditional curb-and-gutter street with a naturalized streetscape modeled after the Seattle SEA Street design. Several LID features were incorporated into the design. The total imperviousness of the street was decreased by reducing the street width from 28 feet to 21 feet with one-



way sections of the road narrowed to 10 feet. Roadside swales that use vegetation and structural grass (grass supported by a grid and soil structure that prevents soil compaction and root damage) were installed to collect and treat stormwater through infiltration.²⁶

Modeling predicts that the redesigned street will retain 90 percent of the annual rainfall volume on-site; the remaining 10 percent of runoff will be treated by the system of vegetated swales before discharging.^{27,28} The City chose to use the LID design because stormwater runoff from Crown Street flows into the last two salmon-bearing creeks in Vancouver.²⁹ Monitoring until 2010 will assess the quality of stormwater runoff and compare it with both the modeling projections and the runoff from a nearby curb-and-gutter street.

The cost of construction for the Crown Street redevelopment was \$707,000. Of this, \$311,000 was attributed to the cost of consultant fees and aesthetic design features, which were included in the project because it was the first of its kind in Vancouver. These added costs would not be a part of future projects. Discounting the extra costs, the \$396,000 construction cost is 9 percent higher than the estimated \$364,000 conventional curb-and-gutter design cost.³⁰ The City has concluded that retrofitting streets that have an existing conventional stormwater system with naturalized designs will cost marginally more than making curb-and-gutter improvements, but installing naturalized street designs in new developments will be less expensive than installing conventional drainage systems.^{31,32}

One goal of Vancouver's Greenways program is to make transportation corridors more pedestrian-friendly. A method used to achieve this goal is to extend curbs at intersections out into the street to lessen the crossing distance and improve the line of sight for pedestrians. When this initiative began, the City relocated stormwater catch basins that would have been enclosed within the extended curb. Now, at certain intersections, the City uses the new space behind the curb to install "infiltration bulges" to collect and infiltrate roadway runoff. The infiltration bulges are constructed of permeable soils and vegetation. (The City of Portland, Oregon, has installed similar systems, which they call "vegetated curb extensions.") The catch basins are left in place, and any stormwater that does not infiltrate into the soil overflows into the storm drain system.³³

The infiltration bulges have resulted in savings for the City. Because the stormwater infiltration bulges are installed in conjunction with planned roadway improvements, the only additional costs associated with the stormwater project are the costs of a steel curb insert to allow stormwater to enter the bulge and additional soil excavation costs. These additional costs are more than offset by the \$2,400 to \$4,000 cost that would have been required to relocate the catch basins. To date, the City has installed nine infiltration bulges, three of which are maintained by local volunteers as part of a Green Streets program in which local residents adopt city green space.³⁴

GAP CREEK SUBDIVISION, SHERWOOD, ARKANSAS

Gap Creek's original subdivision plan was revised to include LID concepts. The revised design increased open space from the originally planned 1.5 acres to 23.5 acres. Natural drainage areas were preserved and buffered by greenbelts. Traffic-calming circles were used, allowing the developer to reduce street widths from 36 to 27 feet. In addition, trees were kept close to the curb line. These design techniques allowed the development of 17 additional lots.



The lots sold for \$3,000 more and cost \$4,800 less to develop than comparable conventional lots. A cost comparison is provided in Table 7. For the entire development, the combination of cost savings and lot premiums resulted in an additional profit to the developer of \$2.2 million.^{35,36}

Table 7. Cost Comparison for Gap Creek Subdivision³⁷

Total Cost of Conventional Design	Gap Creek LID Cost	Cost Savings	Percent Savings	Savings per Lot
\$4,620,600	\$3,942,100	\$678,500	15%	\$4,800

GARDEN VALLEY, PIERCE COUNTY, WASHINGTON (A MODELING STUDY)

The Garden Valley subdivision is a 9.7-acre site in Pierce County, Washington. A large wetland on the eastern portion of the site and a 100-foot buffer account for 43 percent of the site area. Designers evaluated a scenario in which roadway widths were reduced and conventional stormwater management practices were replaced with swales, bioretention, and soil amendments. The use of these LID elements would have allowed the cost for stormwater management on the site to be reduced by 72 percent. A cost comparison is provided in Table 8.³⁸ Other costs expected with the LID design were a \$900 initial cost for homeowner education with \$170 required annually thereafter. Annual maintenance costs for the LID design (not included above) were expected to be \$600 more than those for the conventional design, but a \$3,000 annual savings in the stormwater utility bill was expected to more than offset higher maintenance costs.



Table 8. Cost Comparison for Garden Valley Subdivision³⁹

Item	Conventional Development Cost	Garden Valley LID Cost	Cost Savings*	Percent Savings*
Stormwater management	\$214,000	\$59,800	\$154,200	72%
Site paving	\$110,400	\$200,900	-\$90,500	-82%
Total	\$324,400	\$260,700	\$63,700	—

* Negative values denote increased cost for the LID design over conventional development costs.

The design incorporated the use of narrower roadways coupled with Grasscrete parking along the roadside, which increased the overall site paving costs. However, this added cost was more than offset by the savings realized by employing LID for stormwater management. The LID practices were expected to increase infiltration and reduce stormwater discharge rates, which can improve the health and quality of receiving streams.

KENSINGTON ESTATES, PIERCE COUNTY, WASHINGTON (A MODELING STUDY)

A study was undertaken to evaluate the use of LID techniques at the Kensington Estates subdivision, a proposed 24-acre development consisting of single-family homes on 103 lots. The study assumed that conventional stormwater management practices would be replaced entirely by LID techniques, including reduced imperviousness, soil amendments, and bioretention areas. The design dictated that directly connected impervious areas on-site were to be minimized. Three wetlands and an open space tract would treat stormwater discharging from LID installations. Open space buffers were included in the design. The LID proposal also included rooftop rainwater collection systems on each house.^{40,41}



The proposed LID design reduced effective impervious area from 30 percent in the conventional design to approximately 7 percent, and it was approximately twice as expensive as the traditional design. A cost comparison is provided in Table 9.

Table 9. Cost Comparison for Kensington Estates Subdivision⁴²

Item	Conventional Development Cost	Kensington Estate LID Cost	Additional Cost
Stormwater management	\$243,400	\$925,400	\$ 682,000
Site paving	\$522,300	\$577,500	\$55,200
Total	\$765,700	\$1,502,900	\$737,200

Although the study assumed that roadways in the LID design would be narrower than those in the conventional design, site paving costs increased because the LID design assumed that Grasscrete parking would be included along the roadside to allow infiltration. The use of Grasscrete increased the overall site paving costs.

The avoidance of conventional stormwater infrastructure with the use of LID afforded significant cost savings. The LID measures eliminated the need for a detention pond and made more lots available for development. The significant cost for the rooftop rainwater collection systems was assumed to be offset somewhat by savings on stormwater utility bills.⁴³

The study also anticipated that the use of LID would reduce stormwater peak flow discharge rates and soil erosion. Furthermore, greater on-site infiltration increases ground water recharge, resulting in increased natural baseflows in streams and a reduction in dry channels. Proposed clustering of buildings would allow wetlands and open space to be preserved and create a more walkable community. The reduced road widths were anticipated to decrease traffic speeds and accident rates.

LAUREL SPRINGS SUBDIVISION, JACKSON, WISCONSIN

The Laurel Springs subdivision in Jackson, Wisconsin, is a residential subdivision that was developed as a conservation design community. The use of cluster design helped to preserve open space and minimize grading and paving. The use of bioretention and vegetated swales lowered the costs for stormwater management.



The costs of using conservation design to develop the subdivision were compared with the estimated cost of developing the site with conventional practices (Table 10).⁴⁴ The total savings realized with conservation design were just over \$504,469, or approximately 30 percent of the estimated conventional construction cost. Savings from stormwater management accounted for 60 percent of the total cost savings. Other project savings were realized with reduced sanitary sewer, water distribution, and utility construction costs.

Table 10. Cost Comparison for Laurel Springs Subdivision⁴⁵

Item	Conventional Development Cost	Laurel Springs LID Cost	Cost Savings	Percent Savings	Percent of Total Savings
Site preparation	\$441,600	\$342,000	\$99,600	23%	20%
Stormwater management	\$439,956	\$136,797	\$303,159	69%	60%
Site paving and sidewalks	\$607,465	\$515,755	\$91,710	15%	18%
Landscaping	\$165,000	\$155,000	\$10,000	6%	2%
Total	\$1,654,021	\$1,149,552	\$504,469	—	—

In addition to preserving open space and reducing the overall amount of clearing and grading, the cluster design also reduced street lengths and widths, thereby lowering costs for paving and sidewalks. Vegetated swales and bioswales largely were used to replace conventional stormwater infrastructure and led to significant savings. Each of these factors helped to contribute to a more hydrologically functional site that reduced the total amount of stormwater volume and managed stormwater through natural processes.

MILL CREEK SUBDIVISION, KANE COUNTY, ILLINOIS

The Mill Creek subdivision is a 1,500-acre, mixed-use community built as a conservation design development. Approximately 40 percent of the site is identified as open space; adjacent land use is mostly agricultural. The subdivision was built using cluster development. It uses open swales for stormwater conveyance and treatment, and it has a lower percentage of impervious surface than

conventional developments. An economic analysis compared the development cost for 40 acres of Mill Creek with the development costs of 30 acres of a conventional development with similar building density and location.⁴⁶



When compared with the conventional development, the conservation site design techniques used at Mill Creek saved approximately \$3,411 per lot. Nearly 70 percent of these savings resulted from reduced costs for stormwater management, and 28 percent of the savings were found in reduced costs for site preparation. A cost comparison is provided in Table 11. Other savings not included in the table were realized with reduced construction costs for sanitary sewers and water distribution.

Table 11. Cost Comparison for Mill Creek Subdivision⁴⁷

Item	Conventional Development Cost per Lot	Mill Creek LID Cost per Lot	Cost Savings per Lot	Percent Savings per Lot	Percent of Total Savings
Site preparation	\$2,045	\$1,086	\$959	47%	28%
Stormwater management	\$4,535	\$2,204	\$2,331	51%	68%
Site paving and sidewalks	\$5,930	\$5,809	\$121	2%	4%
Total	\$12,510	\$9,099	\$3,411	—	—

The use of cluster development and open space preservation on the site decreased site preparation costs. The majority of the cost savings were achieved by avoiding the removal and stockpiling of topsoil. In addition to cost savings from avoided soil disturbance, leaving soils intact also retains the hydrologic function of the soils and aids site stormwater management by reducing runoff volumes and improving water quality. The site's clustered design was also responsible for a decrease in costs for paving and sidewalks because the designers intentionally aimed to decrease total road length and width.

The designers used open swales as the primary means for stormwater conveyance. Coupled with other site techniques to reduce runoff volumes and discharge rates, significant savings in stormwater construction were avoided because of reduced storm sewer installation; sump pump connections; trench backfill; and catch basin, inlet, and cleanout installation.

In addition to the cost savings, the conservation design at Mill Creek had a positive effect on property values: lots adjacent to walking/biking trails include a \$3,000 premium, and lots adjacent to or with views of open space include a \$10,000 to \$17,500 premium. The

600 acres of open space on the site include 127 acres of forest preserve with quality wetlands, 195 acres of public parks, and 15 miles of walking/biking trails.⁴⁸

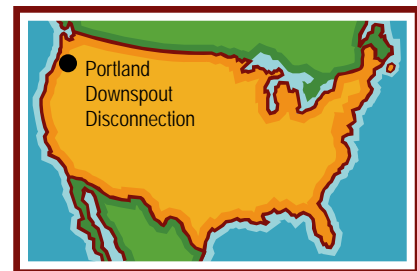
POPLAR STREET APARTMENTS, ABERDEEN, NORTH CAROLINA

The use of bioretention, topographical depressions, grass channels, swales, and stormwater basins at the 270-unit Poplar Street Apartment complex improved stormwater treatment and lowered construction costs. The design allowed almost all conventional underground storm drains to be eliminated from the design. The design features created longer flow paths, reduced runoff volume, and filtered pollutants from runoff. According to the U.S. Department of Housing and Urban Development, use of LID techniques resulted in a \$175,000 savings (72 percent).⁴⁹



PORTLAND DOWNSPOUT DISCONNECTION PROGRAM, PORTLAND, OREGON

The City of Portland, Oregon, implemented a Downspout Disconnection Program as part of its CSO elimination program. Every year, billions of gallons of stormwater mixed with sewage pour into the Willamette River and Columbia Slough through CSOs. When roof runoff flows into Portland's combined sewer system, it contributes to CSOs. The City has reduced the frequency of CSOs to the Columbia Slough and hopes to eliminate 94 percent of the overflows to the Willamette River by 2011.⁵⁰



The Downspout Disconnection Program gives homeowners, neighborhood associations, and community groups the chance to work as partners with the Bureau of Environmental Services and the Office of Neighborhood Involvement to help reduce CSOs. Residents of selected neighborhoods disconnect their downspouts from the combined sewer system and allow their roof water to drain to gardens and lawns. Residents can do the work themselves and earn \$53 per downspout, or they can have community groups and local contractors disconnect for them. Community groups earn \$13 for each downspout they disconnect. (Materials are provided by the City.)

More than 44,000 homeowners have disconnected their downspouts, removing more than 1 billion gallons of stormwater per year from the combined sewer system. The City estimates that removing the 1 billion gallons will result in a \$250 million reduction in construction costs for an underground pipe to store CSOs by reducing the capacity needed to handle the flows. The City has spent \$8.5 million so far to implement this program and will continue to encourage more homeowners and businesses to disconnect their downspouts to achieve additional CSO and water quality benefits.

PRAIRIE CROSSING SUBDIVISION, GRAYSLAKE, ILLINOIS

The Prairie Crossing subdivision is a conservation development on 678 acres, of which 470 acres is open space. The site was developed as a mixed-use community with 362 residential units and 73 acres of commercial property, along with schools, a community center, biking trails, a lakefront beach, and a farm. The site uses bioretention cells and vegetated swales to manage stormwater.⁵¹



A cost analysis was performed to compare the actual construction costs of Prairie Crossing with the estimated costs of a conventional design on the site with the same layout. Cost savings with conservation design were realized primarily in four areas: stormwater management, curb and gutter installation, site paving, and sidewalk installation. The total savings were estimated to be almost \$1.4 million, or nearly \$4,000 per lot (Table 12). Savings from stormwater management accounted for approximately 15 percent of the total savings. The cost savings shown are relative to the estimated construction cost for the items in a conventional site design based on local codes and standards.

Table 12. Cost Comparison for Prairie Crossing Subdivision⁵²

Item	Cost Savings	Percent Savings
Reduced Road Width	\$178,000	13%
Stormwater Management	\$210,000	15%
Decreased Sidewalks	\$648,000	47%
Reduced Curb and Gutter	\$339,000	25%
Total	\$1,375,000	—

Reduced costs for sidewalks accounted for nearly half of the total cost savings. This savings is attributed in part to the use of alternative materials rather than concrete for walkways in some locations. In addition, the design and layout of the site, which retained a very high percentage of open space, contributed to the cost savings realized from reducing paving, the length and number of sidewalks, and curbs and gutters. The use of alternative street edges, vegetated swales, and bioretention and the preservation of natural areas all reduced the need for and cost of conventional stormwater infrastructure.⁵³ Benefits are associated with the mixed-use aspect of the development as well: residents can easily access schools, commercial areas, recreation, and other amenities with minimal travel. Proximity to these resources can reduce traffic congestion and transportation costs. Also, mixed-use developments can foster a greater sense of community and belonging than other types of development. All of these factors tend to improve quality of life.

PRAIRIE GLEN SUBDIVISION, GERMANTOWN, WISCONSIN

The Prairie Glen subdivision is nationally recognized for its conservation design approach. A significant portion of the site (59 percent) was preserved as open space. Wetlands were constructed to manage stormwater runoff, and the open space allowed the reintroduction of native plants and wildlife habitat. The site layout incorporated hiking trails, which were designed to allow the residents to have easy access to natural areas.⁵⁴



To evaluate the cost benefits of Prairie Glen's design, the actual construction costs were compared with the estimated costs of developing the site conventionally. When compared with conventional design, the conservation design at Prairie Glen resulted in a savings of nearly \$600,000. Savings for stormwater management accounted for 25 percent of the total savings. Table 13 provides a cost comparison. Other savings not included in the table were realized with reduced sanitary sewer, water distribution, and utility construction costs.

Table 13. Cost Comparison for Prairie Glen Subdivision⁵⁵

Item	Conventional Development Cost	Prairie Glen LID Cost	Cost Savings*	Percent Savings*	Percent of Total Savings*
Site preparation	\$277,043	\$188,785	\$88,258	32%	22%
Stormwater management	\$215,158	\$114,364	\$100,794	47%	25%
Site paving and sidewalks	\$462,547	\$242,707	\$219,840	48%	54%
Landscaping	\$50,100	\$53,680	-\$3,580	-7%	-1%
Total	\$1,004,848	\$599,536	\$405,312	—	—

* Negative values denote increased cost for the LID design over conventional development costs.

The cluster design and preservation of a high percentage of open space resulted in a significant reduction in costs for paving and sidewalks. These reduced costs accounted for 54 percent of the cost savings for the overall site. Reduced costs for soil excavation and stockpiling were also realized. The use of open-channel drainage and bioretention minimized the need for conventional stormwater infrastructure and accounted for the bulk of the savings in stormwater management. Landscaping costs increased due to the added amount of open space on the site.

SOMERSET SUBDIVISION, PRINCE GEORGE'S COUNTY, MARYLAND

The Somerset subdivision, outside Washington, D.C., is an 80-acre site consisting of nearly 200 homes. Approximately half of the development was built using LID techniques; the other half was conventionally built using curb-and-gutter design with detention ponds for stormwater management.



Bioretention cells and vegetated swales were used in the LID portion of the site to replace conventional stormwater infrastructure. Sidewalks were also eliminated from the design. To address parking concerns, some compromises were made: because of local transportation department concern that roadside parking would damage the swales, roads were widened by 10 feet.⁵⁶ (Note that there are alternative strategies to avoid increasing impervious surface to accommodate parking, such as installing porous pavement parking lanes next to travel lanes.)

Most of the 0.25-acre lots have a 300- to 400-square-foot bioretention cell, also called a rain garden. The cost to install each cell was approximately \$500—\$150 for excavation and \$350 for plants. The total cost of bioretention cell installation in the LID portion of the site was \$100,000 (swale construction was an additional cost). The construction cost for the detention pond in the conventionally designed portion of the site was \$400,000, excluding curbs, gutters, and sidewalks.^{57,58} By eliminating the need for a stormwater pond, six additional lots could be included in the LID design. A comparison of the overall costs for the traditional and LID portions of the site is shown in Table 14.

Table 14. Cost Comparison for Somerset Subdivision

Conventional Development Cost	Somerset LID Cost	Cost Savings	Percent Savings	Savings per Lot
\$2,456,843	\$1,671,461	\$785,382	32%	\$4,000

In terms of environmental performance, the LID portion of the subdivision performed better than the conventional portion.⁵⁹ A paired watershed study compared the runoff between the two portions of the site, and monitoring indicated that the average annual runoff volume from the LID watershed was approximately 20 percent less than that from the conventional watershed. The number of runoff-producing rain events in the LID watershed also decreased by 20 percent. Concentrations of copper were 36 percent lower; lead, 21 percent lower; and zinc, 37 percent lower in LID watershed runoff than in conventional watershed runoff. The homeowners' response to the bioretention cells was positive; many perceived the management practices as a free landscaped area.

TELLABS CORPORATE CAMPUS, NAPERVILLE, ILLINOIS

The Tellabs corporate campus is a 55-acre site with more than 330,000 square feet of office space. After reviewing preliminary planning materials that compared the costs of conventional and conservation design, the company chose to develop the site with conservation design approaches. Because the planning process included estimating costs for the two development approaches, this particular site provides good information on commercial/industrial use of LID.⁶⁰



Development of the site included preserving trees and some of the site's natural features and topography. For stormwater management, the site uses bioswales, as well as other infiltration techniques, in parking lots and other locations. The use of LID techniques for stormwater management accounted for 14 percent of the total cost savings for the project. A cost comparison is provided in Table 15. Other cost savings not shown in Table 15 were realized with reduced construction contingency costs, although design contingency costs were higher.

Table 15. Cost Comparison for Tellabs Corporate Campus⁶¹

Item	Conventional Development Cost	Tellabs LID Cost	Cost Savings	Percent Savings	Percent of Total Savings
Site preparation	\$2,178,500	\$1,966,000	\$212,500	10%	46%
Stormwater management	\$480,910	\$418,000	\$62,910	13%	14%
Landscape development	\$502,750	\$316,650	\$186,100	37%	40%
Total	\$3,162,160	\$2,700,650	\$461,510	—	—

Savings in site preparation and landscaping had the greatest impact on costs. Because natural drainage pathways and topography were maintained to the greatest extent possible, grading and earthwork were minimized; 6 fewer acres were disturbed using the conservation design approach. Landscaping at the site maximized natural areas and restored native prairies and wetland areas. The naturalized landscape eliminated the need for irrigation systems and lowered maintenance costs when compared to turf grass, which requires mowing and regular care. In the end, the conservation approach preserved trees and open space and provided a half acre of wetland mitigation. The bioswales used for stormwater management complemented the naturalized areas and allowed the site to function as a whole; engineered stormwater techniques augmented the benefits of the native areas and wetlands.⁶²

TORONTO GREEN ROOFS, TORONTO, ONTARIO (A MODELING STUDY)

Toronto is home to more than 100 green roofs. To evaluate the benefits of greatly expanded use of green roofs in the city, a study was conducted using a geographic information system to model the effects of installing green roofs on all flat roofs larger than 3,750 square feet. (The model assumed that each green roof would cover at least 75 percent of the roof area.) If the modeling scenario were implemented, 12,000 acres of green roofs (8 percent of the City's land area) would be installed.⁶³ The study quantified five primary benefits from introducing the green roofs: (1) reduced stormwater flows into the separate storm sewer system, (2) reduced stormwater flows into the combined sewer system, (3) improved air quality, (4) mitigation of urban heat island effects, and (5) reduced energy consumption.⁶⁴



The study predicted economic benefits of nearly \$270 million in municipal capital cost savings and more than \$30 million in annual savings. Of the total savings, more than \$100 million was attributed to stormwater capital cost savings, \$40 million to CSO capital cost savings, and nearly \$650,000 to CSO annual cost savings. The cost of installing the green roofs would be largely borne by private building owners and developers; the cost to Toronto would consist of the cost of promoting and overseeing the program and would be minimal. Costs for green roof installations in Canada have averaged \$6 to \$7 per square foot. The smallest green roof included in the study, at 3,750 square feet, would cost between \$22,000 and \$27,000. The total cost to install 12,000 acres of green roofs would be \$3 billion to \$3.7 billion.^{65,66} Although the modeled total costs exceed the monetized benefits, the costs would be spread across numerous private entities.

CONCLUSION

The 17 case studies presented in this report show that LID practices can reduce project costs and improve environmental performance. In most cases, the case studies indicate that the use of LID practices can be both fiscally and environmentally beneficial to communities. As with almost all such projects, site-specific factors influence project outcomes, but in general, for projects where open space was preserved and cluster development designs were employed, infrastructure costs were lower. In some cases, initial costs might be higher because of the cost of green roofs, increased site preparation costs, or more expensive landscaping practices and plant species. However, in the vast majority of cases, significant savings were realized during the development and construction phases of the projects due to reduced costs for site grading and preparation, stormwater infrastructure, site paving, and landscaping. Total capital cost savings ranged from 15 to 80 percent when LID methods were used, with a few exceptions in which LID project costs were higher than conventional stormwater management costs.

EPA has identified several additional areas that will require further study. First, in all the cases, there were benefits that this study did not monetize and factor into the project's bottom line. These benefits include improved aesthetics, expanded recreational opportunities, increased property values due to the desirability of the lots and their proximity to open space, increased number of total units developed, the value of increased marketing potential, and faster sales.

Second, more research is also needed to quantify the environmental benefits that can be achieved through the use of LID techniques and the costs that can be avoided by using these practices. For example, substantial downstream benefits can be realized through the reduction of the peak flows, discharge volumes, and pollutant loadings discharged from the site. Downstream benefits also might include reductions in flooding and channel degradation, costs for water quality improvements, costs of habitat restoration, costs of providing CSO abatement, property damage, drinking water treatment costs, costs of maintaining/dredging navigable waterways, and administrative costs for public outreach and involvement.

Finally, additional research is needed monetize the cost reductions that can be achieved through improved environmental performance, reductions in long-term operation and maintenance costs and/or reductions in the life cycle costs of replacing or rehabilitating infrastructure.

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⁴ The term *LID* is one of many used to describe the practices and techniques employed to provide advanced stormwater management; *green infrastructure*, *conservation design*, and *sustainable stormwater management* are other common terms. However labeled, each of the

identified practices seeks to maintain and use vegetation and open space, optimize natural hydrologic processes to reduce stormwater volumes and discharge rates, and use multiple treatment mechanisms to remove a large range of pollutants. In the context of this report, case studies ascribing to one of the above, or similar, labels were evaluated, and these terms are used interchangeably throughout the report.

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Seattle Public Utilities – Natural Drainage System Program

Problem Statement: Seattle’s receiving waters and aquatic life have been significantly impaired by the negative impacts of urban stormwater runoff. Increasing volumes of runoff also cause flooding of roadways and property. Traditional methods of stormwater management and street design have proven to be ineffective at countering the impacts of current and future development on receiving waters.

Natural Drainage Systems (NDS) is an alternative stormwater management approach that delivers higher levels of environmental protection for receiving waters at a lower cost than traditional street and drainage improvements.

- NDS targets areas of the city draining to creek watersheds that do not currently have formal drainage or street improvements.
- NDS design is based on technology that emphasizes infiltration and decentralized treatment of stormwater to reduce the total volume of runoff reaching creek systems.
- The goal of NDS is to more closely match the hydrologic function of natural forests that existed prior to development, thereby creating stable creek systems and clean water.
- NDS designs cost less than traditional drainage and street designs.

Cost Analysis of Natural vs. Traditional Drainage Systems Meeting NDS Stormwater Goals

Street Type	<i>Local street</i> SEA Street	<i>Local street</i> Traditional	<i>Collector street</i> Cascade	<i>Collector street</i> Traditional	Broadview Green Grid 15 block area
Community Benefits	<ul style="list-style-type: none">▪ one sidewalk per block▪ new street paving▪ traffic calming▪ high neighborhood aesthetic	<ul style="list-style-type: none">▪ two sidewalks per block▪ new street paving▪ no traffic calming▪ no neighborhood aesthetic	<ul style="list-style-type: none">▪ no street improvement▪ moderate neighborhood aesthetic	<ul style="list-style-type: none">▪ no street improvement▪ no neighborhood aesthetic	<ul style="list-style-type: none">▪ both ‘SEA Street’ and ‘Cascade’ types▪ one sidewalk per block▪ new paving▪ high neighborhood aesthetic
Ecological Benefits	<ul style="list-style-type: none">▪ high protection for aquatic biota▪ mimics natural process▪ bio-remediate pollutants	<ul style="list-style-type: none">▪ high protection from flooding▪ some water quality	<ul style="list-style-type: none">▪ high water quality protection▪ some flood protection	<ul style="list-style-type: none">▪ high protection from flooding▪ some water quality	<ul style="list-style-type: none">▪ high water quality & aquatic biota protection▪ some flood protection▪ excellent monitoring opportunity
% impervious area	35%	35%	35%	35%	35%
Cost per block (330 linear feet)	\$325,000	\$425,000	\$285,000	\$520,400	Average per block: \$280,000

City of Seattle Operation and Maintenance Cost Estimates¹

The City of Seattle has collected some initial data on the operation and maintenance costs for bioswale vegetation. The operation and maintenance costs for the first three years of the city's SEA Streets projects are outlined below. The City of Seattle's natural drainage projects were initiated under the assumption that residents will take on a portion of the maintenance responsibilities.

City of Seattle's Estimates for the Maintenance Costs of Bioretention Swale Vegetation.

LOS B – 47-290 SQ. FT	Total Present Value	Annual Value
Initial 3 year Landscape Establishment		
Assuming 0% community participation	\$177,614	\$65,221
Established (starting year 4, assuming 20 years of payments)		
0% community participation	\$562,228	\$28,615
25% community participation	\$421,671	\$21,461
50% community participation	\$281, 114	\$14,308
75% community participation	\$140,557	\$7,154
90% community participation	\$56,223	\$2,862
Soil Replacement (every 15 years)²	\$466,952	\$23,527

The City of Seattle decides what level of service (LOS) will be applied to each facility, where the LOS ranges from A-D with A being excellent service and D being poor service. The 'Total Present Value' is the cost of the maintenance in 2007 dollars for future payments, discounted at 5% to reflect the time value of money. The 'Annual Value' is the cost of the maintenance for the year in 2007 dollars. The City assumes responsibility of bioretention swales for the first three years until the plants are established. After the third year, the maintenance costs are estimated based on the level of community participation for required maintenance.

¹ From Seattle Public Utilities. Presentation by Drena Donofrio at the LID Technical Class Series hosted by WSU Extension and the Puget Sound Partnership, Bellingham, September 10-11, 2008.

² Assumes soil needs to be replaced. Initial investigations of bioretention soil quality on the U.S. east coast indicates that after ten years bioretention soils did not need to be replaced.

Standard Test Methods for Pervious Pavements

The following is a list of test methods that have been developed or are currently under development and that may be useful for developing local pervious concrete standards. This list was developed by Liv Haselbach, P.E., PhD, LEED® AP, Associate Professor Civil and Environmental Engineering, Washington State University, Pullman, WA.

- a) Testing Methods for Acceptance of Product from the Producer
 - i) ASTM ____: Fresh Concrete Density (Unit Weight) and Void Content
 - This method is still under Development by ASTM C09/49 Pervious Concrete. Anticipated to be finalized in 2009.
- b) Installed Pavement Testing Methods
 - i) ASTM ____: Field Permeability (Infiltration Rate)
 - Under Development by ASTM C09/49 Pervious Concrete. Anticipated to be finalized in 2009 or 2010. Expected method title: “Standard Test Method for Infiltration Rate of In Place Pervious Concrete”.
 - ii) ASTM ____: Compressive Strength
 - Under Development by ASTM C09/49 Pervious Concrete
 - iii) ASTM ____: Hardened Concrete Density and Porosity
 - Under Development by ASTM C09/49 Pervious Concrete
 - A similar method is also being developed by the ASTM-equivalent organization in Canada.
 - iv) ASTM ____: Flexural Strength
 - Under Development by ASTM C09/49 Pervious Concrete
- c) Miscellaneous Testing Methods
 - i) Haselbach, L.M., and Freeman, R.M., “Effectively Estimating In-situ Porosity of Pervious Concrete from Cores”, *Journal of ASTM International*, 4(7), 2007.
 - ii) Montes, F., Valavala, S., and Haselbach, L., “A New Test Method for Porosity Measurements of Portland Cement Pervious Concrete”, *Journal of ASTM International*, 2(1), 2005.
 - iii) Crouch, L. K., Cates, M. A., Dotson, V. J., Honeycutt, K. R., and Badoe, D. A., “Measuring the Effective Air Void Content of Portland Cement Pervious Pavements”, *Cement, Concrete and Aggregates*, 25(1), 2003.

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Stormwater

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Stormwater Utility User Fee Credits

Everything should be made as simple as possible; but not simpler. —Albert Einstein

By Andrew J. Reese

The establishment of stormwater utilities is fast becoming a “commodity” consulting service as smaller and smaller local entities decide to make the leap to user fee–based funding.

While the complexity of the stormwater program and the number of zeros at the end of the budget may be reduced, the need for well-thought-through, equitable, and legal policies has not diminished. In fact, in smaller towns, the need, for example, for perceived equity is often *greater* because people tend to know when questionable deals or bone-headed decisions have been made. There are fewer places to hide.

One area of interesting abuse, amazing ingenuity, and sometimes Rube Goldberg–esque complexity is in the area of stormwater credits. (For those of you less than 50 years old, Rube Goldberg was a cartoonist who developed marvelously complex contraptions to simple everyday things. Find out more at http://en.wikipedia.org/wiki/Rube_Goldberg.) This article is about how not to do it that way.

Background and Theory

The use of stormwater utility methods for financing urban stormwater programs is growing rapidly in popularity in the United States. Utilities have a proven track record of revenue stability, equitability of charges, and revenue sufficiency to support growing stormwater management programs. There are well over 600 such utilities presently in existence and many more in the planning stages. The rate structures of such utilities are becoming more complex as more and more cities turn to this method for stormwater financing in support of water-quality programs and green, low-impact development (LID), and sustainable design approaches.

Stormwater utilities typically generate most of their revenue through user fees. “Use” of the stormwater system is defined as the demand a property places on that system and the fact that it makes use of the stormwater services and facilities provided that protect their property, downstream properties, streets, aesthetics, and receiving-water quality (note that “benefit” is not part of the consideration under a user fee approach, as opposed to a special assessment or benefit assessment approach). The demand a property places on a system has traditionally been measured in terms of the peak flow of stormwater runoff generated by the property. The greater the flow, the greater the use and thus the greater the user fee. More recently two other major components of comprehensive urban stormwater program costs have been more commonly recognized within rate structures: volume of runoff and pollution. Volume correlates better to overall maintenance demands while pollution correlates well with the water-quality and compliance costs.

The two major parameters that most significantly influence the demand that a property places on the stormwater system and, less directly, the costs attributable to that property are total property area and some measurement of development, normally an estimate that reflects impervious area. Many stormwater utilities do not consider total area since undeveloped property may have little or no greater impact than it had before the existence of the city itself. Others actually reduce the fee a property pays if it preserves green areas (i.e. is larger). Imperviousness is handled either as a measured or estimated area, through an intensity of development method, by calculating a runoff coefficient, or by using directly connected impervious area only—all to say, “There are no cookie cutters.” Those who use a one-size-fits-all approach (or do a global name change on a neighbor’s rate ordinance) normally are sorry in the end.

In a typical stormwater rate structure both secondary funding methods and rate modifiers are often used to simplify program development and administration, improve equity, provide incentives for private actions that benefit the city’s stormwater management programs, and provide ratepayers a way to reduce their service charge if they meet appropriate

conditions. Secondary funding methods include plans review and inspection fees, fees in lieu of, latecomer fees, and many more. Rate modifiers often include one or more tiers of flat rates for single-family residences, fixed cost per account, and various other rate or billing adjustments.

Another rate modifier that fits within the overall rate structure is the use of a crediting mechanism to reduce the fee a property owner would pay. They are important in several ways:

Credits typically do not have significant total utility revenue reduction potential (often less than 2% to 5% if a “pull” versus a “push” marketing approach is used to advertise them) but may have large potential in reducing the resistance to the utility concept from large fee payers or others who would qualify for a credit.

One way a fee differs from a tax is that the customer is able to refuse service and that the provision of service is largely voluntary in nature. Credits may also satisfy the legal “requirement” that a customer is able to refuse service and that use of it is voluntary. (This idea is perhaps not as viable as it appeared when it first was used in several court cases. Most customers have little ability to refuse water or sewer service, and many pay some sewer or water fee due to the “availability” of the service. Thus, a stormwater utility mimics these other utilities not because a customer can totally refuse service and payment of the fee but because the customer can do certain things to reduce his demand or use of the public system and thus reduce his fee as well.)

Credits are also one of only a few ways stormwater utilities have to encourage sound development using a “carrot” rather than a “stick.” As such, they carry an importance far beyond their actual revenue significance.

There is a difference between a one-time credit (often termed an *offset*) and an ongoing credit. For the purposes of this article only ongoing credits will be discussed. So for our purposes a stormwater utility credit is an ongoing reduction in a property’s stormwater user fee given for certain qualifying activities.

There is a downside to credits too. They can be (1) complex and costly to initially determine, (2) hard to administer and police, (3) not large enough to actually encourage good stormwater behavior, and (4) often mismatched in the development process in that it is the developer who most often must make the decision to build something credit-worthy into the site, but it is not the developer who profits from the ongoing credit—it is the owner.

There is a cost to a local community having a credits program that must be factored into the stormwater cost of service. This cost can be minimized when the credits granted are calculated as part and parcel with the design-plans review-inspection process and realized in the course of meeting design standards.

Bases for Stormwater Credits

What are those “ongoing” activities? Why should someone receive a credit?

Prior to discussing these various bases for applying credits, let’s remind ourselves, as was pointed out earlier, that any user fee itself must have some basis for calculation and application. That basis is some measurement of “use” of the public stormwater system or “use” of the results of the public system being applied upstream of me, around me, or within my city or county.

Also, based on a growing body of case law, for stormwater fees to be strictly legal in most states they should, among other things, be legal by charter and enforceable by law, be fair and reasonable, be equitable and non-arbitrary or capricious, have a sound monotonically increasing rational nexus, not be illegally discriminatory, and bear a substantial relationship to the costs of providing the services and facilities for which the fee is paid rather than to defray general expenses of the city. Additionally the process for arriving at a rate level and carrying out the rate must have followed stipulated procedures for public hearings and rate analysis.

In a perfect world credits should be derived and applied on the same basis as rates. Like my old professor used to say, “I don’t give grades; you earn them.” In the same way credits are not given—they are earned.

In that utopian world there are really only two main bases for a stormwater credit that pass this rate-paralleling muster. Those two are:

I obtain a stormwater credit because I take some ongoing action on my property that reduces its actual use of, or impact on, the downstream stormwater system to a level below that which would be reflected in the physical parcel measurement that determines my user fee.

I do some activity, operate some program, or perform some function that, in an ongoing way, reduces the overall cost of the stormwater program for the local government and thus obtain some, or all, of my cost of such performance back in the form of a credit.

Having said that, there are stormwater credits that are offered on a large number of bases and reflecting a large number of reasons (some of them strictly political) as well. Some of the most common are:

A class of ratepayers

The class of property

Location within the watershed or service area

“Other” (you would be better off not knowing!)

Credits Based on Classes of Payers

Credits granted on the basis of a classification of ratepayers may or may not be appropriate, depending on what criteria are used in the classification. Most legitimate reductions in user fees based on classes of users are not handled through

credits but through the rate methodology itself. Less imperviousness is its own reward.

Other classification criteria may reflect the economic situation or status of the ratepayers. For example, lower-income or elderly fixed-income individuals may pay a lesser amount. Although this credit basis may involve widely held and morally defensible social purposes or values, it has a technical shortcoming in that economic status criteria are not related to the reason the fee is imposed in the first place. Despite this significant shortcoming, economic-status-based reductions in service charges have been offered in some communities for water, sewer, and electric charges for lower-income individuals.

Common to water and sewer rate making is considering the affordability of its combined bills on several bases, one of which is the household affordability ratio (HAR). The HAR analysis compares total annual water-related utility charges (i.e., water, sewer, stormwater) to median annual household income. EPA guidelines suggest that for combined water and sewer a HAR value that is greater than or equal to 4% would impose a significant economic hardship and a HAR between 2.0 and 3.9 would cause a moderate hardship for some households. In such cases there are a variety of ways to provide the credit or to simply reduce the fee in the first place through the rate structure. It is often difficult to make such a determination, and utilities are often reluctant to delve into the personal income, etc., of its customers. Some simply either rely on other social agencies to provide a list or use the lists of other utilities such as electric or solid waste.

One way out of this catch 22 is to grant such rebates of fees apart from the utility rate process, such as general fund allocations to pay utility charges of economically disadvantaged persons. This then becomes a policy decision based on non-technical merit and not a part of the rate structure itself, but through an ancillary program.

Credits Based on Classes of Property

Credits based on classes of property can be divided into three groups: private property classes, state and federal government property classes, and local government property classes.

Private, *tax-exempt properties* impose demands on stormwater systems, but tax-based funding does not generate revenue to cover the cost of service to these properties. Recovering this revenue is often cited as a key justification for the utility rather than the tax-based approach. As in the previous case, exemptions that exclude tax-exempt properties from a stormwater service charge violate the technical basis for a user fee. Court challenges by tax-exempt properties have failed on the basis that the charge is a fee and not a tax. Drawing from these cases, it might be surmised that exempting a class of properties based on tax status may jeopardize the basis of the utility itself. It seems “the rain falls on the just and the unjust.”

Agricultural and “undeveloped” properties offer another type of private property class. It can be argued (and has been in the courts) that this type of property does not affect the stormwater system adversely because the infiltration capabilities of the property are not diminished when compared to “natural” conditions. This may be true in the case of natural forested areas. For open grassy areas the runoff may be greater due to the loss of the rainfall retention properties of forest leaf and litter and the work of the trees taking up water. For agricultural and intensively maintained recreational areas (such as golf courses) it can be argued that stormwater quantity and the pollution and sediment loading is far greater than in the natural state. In this case partial or total payment of the fee could be warranted. A credit may then be granted for onsite practices that reduce stormwater quantity or pollutant loading, provided maintenance is provided to ensure proper operation of best management practices and provided the program and rate structure in some way reflect these costs. If undeveloped property is not charged a fee, then a credit should not be granted where no fee is charged. In these cases cities rely on federal and state mechanisms to encourage sound agricultural or land-use practices apart from the stormwater utility user fee and credits.

Often, for the sake of convenience, *individual residential properties* are not afforded the credit opportunities of larger non-residential properties. Activities an individual homeowner could take to reduce stormwater pollution are minor (though can be major in aggregate) and impossible to monitor. This presents a conceptual problem in that other water-related utility fees are entered into on a more or less voluntary basis (though there are often few other options) and charged on the basis level of consumption or use of a service, while a stormwater fee is compulsory (Lindsey 1990). All property owners are users of, or benefit from, a properly functioning stormwater system. To partially address this problem, some cities allow residential developments with homeowner associations to be treated like other non-residential properties for credits or, in the case of a whole subdivision that is designed with low-impact development (LID) or other green design features, a reduced fee is applied across the board to every property within that subdivision without regard to actual lot-by-lot inspection or analysis.

State and federal facilities do not pay local property taxes. Charging them a stormwater user fee (or service charge) becomes a new source of revenue for the city and broadens the rate base. Most cities charge these classes of properties. This charge has been challenged in the courts with mixed results, though recently the famous Cincinnati case has taken a first step toward probable reversal, allowing for charges to be levied on federal property.

This type of charge becomes quite complex in the case of charging states and the federal government for *runoff from roadways*. In some states, counties do not own or operate roads. If such a county should institute a stormwater fee, the charge to the state could be unreasonably large. In that case efforts can be made to seek credits based on extraordinary circumstances rather than a class exemption. For example:

The charge could be waived or reduced if the entity maintains its own stormwater system and handles the flow of city or county water adequately through its system.

In other cases the charge is reduced, reasoning that part of the street is actually stormwater conveyance and not imperviousness per se.

In still other cases the charge has been upheld in the courts if the city or county charges itself for its own roads, which amounts to a municipal paper transaction from the general fund to the utility enterprise fund.

Local government properties are not subject to property taxes. The case can be made to exempt all local government properties from the stormwater fee since the source of the funds, the local community, is the same in any case. All local private property owners and other taxpayers participate in the ownership and management costs of these public properties through their private property taxes. Therefore, the exemption of local government properties from stormwater charges normally is relatively revenue neutral.

However, *taxpayer* and *ratepayer* are not equivalent terms. The owner of an individual parcel of property, based on land value, will pay one amount in support of stormwater while that same property owner, treated as a ratepayer, would pay a different amount. For example, a skyscraper would pay a much higher amount under a tax-based system than a user fee-based system. A shift from tax-based funding to user fee-based funding will normally slightly shift the cost burden toward the aggregate of non-residential properties. However, in any individual parcel's case the cost may be more than its share under tax-based funding. If a policy decision is made to charge all state and federal government or public facilities for stormwater runoff, then local publicly owned property should also be charged.

Credits Based on Location of Property

It can be argued that properties located adjacent to major streams do not make use of the urban stormwater system in the same way properties do that are located elsewhere in the system. Some cities have granted some measure of credit for those properties that are located adjacent to and discharge directly into major streams or creeks. Such an argument taken to its logical conclusion would result in differing charges based on differing locations throughout the watershed. This is clearly unworkable. It is not done in the case of water or wastewater rates.

While properties adjacent to major streams and rivers do not make direct use of as much of the local urban stormwater system as properties located at the top of the watershed, there are also strong justifications for not granting them credits. Because of their riparian rights as owners of lands through which, or adjacent to which, streams flow, these properties are the primary, and often exclusive, beneficiaries of all systems and activities designed to reduce flooding, reduce flood insurance rates, regulate floodplains, stabilize rivers and streams, develop greenways, and clean up surface water. In fact, in some cities, a surcharge is imposed on floodplain-located properties to pay for the city's floodplain administration costs. On balance, it might be stated that the farther from the watershed outfall, the more use is made of the system, while the closer to the watershed outfall, the more benefit is enjoyed from proper working of the system.

Also, all properties, regardless of location, benefit from installation of an adequate stormwater management system, and the proof of special benefit assigned to each property is not necessary (Hartigan 1989, *Teter v. Clark County* 1985). All property owners share in the general benefits of cleaner water, safe streets during storms, and sounder development practices.

Adequate Basis for Credits

The two "airtight" bases for granting credits are discussed here. Just because they are legally defensible does not make them simple to apply, though. So, keeping Einstein's quote in mind, let's discuss these two bases in real-world applications.

The typical basic guiding principle in developing and granting stormwater credits based on impact and cost reduction can be stated as follows: Credit should be given for approved private investments or actions commensurate with reduced public cost or that produce a stormwater-related public good that is ongoing. Under this guiding principle, there are a number of ways to look at how credits could theoretically be justified and applied. Table 1 gives some examples, some of which are discussed below. As you think about these credits keep in mind that some of them could equally be applied as part of the rate structure and not as a rate modifier. For example, disconnected imperviousness or green roof areas could simply be billed at a lower level.

Credit Based on Reduction of Individual Use or Impact

The basis for an individual parcel's stormwater utility fee is twofold: the total cost of the stormwater program and the impact or use of each property on the stormwater and stream systems. This impact is typically approximated by measuring impervious area. However, there are many other impacts of urban development, including higher peaks, more "flashy" peaks, higher velocities, more total flow volume, higher levels of pollution, more erosion and/or sediment, less

long-term base flow, and higher temperatures.

Most cities that have used an impact-based crediting mechanism have concentrated on providing credit for the reduction of peak flows. This credit is granted for the provision of detention or retention ponds. Many equations or rules have been employed using both fixed credit proportions or a sliding scale based on the amount of the peak flow reduction. One city, for example, uses a sliding scale that moves from a minimum of 20% credit for a basic detention pond and a simplified application procedure to a maximum potential of an 80% credit for over-design to correct downstream problems. Another sliding scale method is to use the concept of “effective impervious area.” To the extent owners make their property respond, in terms of hydrologic or other impact, as if it is less impervious it is appropriate to allow a credit. For example, if a property owner makes the hydrologic response from 4 acres of impervious area respond like it is 2 acres of impervious area, the owner might get a 50% reduction of the fee. This fits well into the basic guiding premise of LID designs—mimic pre-development hydrology: volume, timing, pollution.

The difficulties in applying impact-based credits more broadly follow:

- How to define a standard against which the system is judged
- How to define the impacts a property has on stormwater systems
- How to measure reduction in these impacts and associated reductions in the cost of service
- How to assign costs of service to the impact
- How to accommodate historical shifts in design standards
- How much of the fee to make subject to crediting

It must be realized at the outset that a credit is not a strict engineering calculation. It does not have to be exactly predictive of, but only bear a relationship to, reductions in impact. Therefore, great simplifications not acceptable for engineering applications are quite adequate for crediting mechanisms. Courts have upheld rate structures, presumably including crediting mechanisms, based on what some have considered crude approximations. Much depends on the legal authority granted to cities, counties, or utilities by a particular state and charter. Also, credits for individual sites are no substitute for overall basin-wide multiobjective master planning resulting in a combination of both onsite and regional structural and non-structural practices. Every credited stormwater management facility should be planned and engineered to be both necessary and effective.

As a result of federal (e.g., NPDES, Section 319) or state program requirements, most local governments are looking at ways to apply stormwater utility credits for pollution avoidance or reduction activities. The “polluters must pay” theory of financing pollution-related impacts can be used in reverse as a basis for credits. Some cities approach this problem in a way to provide a financial incentive for many categories of pollution reduction mechanisms, both structural and non-structural. They propose using an inspector checklist and point rating system for the development of credits. Others have approached this problem by dividing the total fee among urban development impacts—for example, peak, volume, and pollution reduction.

Some give credit for industries that maintain current National Pollutant Discharge Elimination System (NPDES) permits for stormwater discharge. Credit should not be given to reward someone for reduction or elimination of illegal activities. Therefore, credit for disconnecting floor drain connections to storm systems would not be granted in locations where such practices are illegal anyway.

Newer LID-type designs fit into this category. And they currently have the same difficulty. In BMP design, because of lack of comprehensive data and information, “presumptive” benefits are normally calculated based on sound design standards. It is then reasoned that if the design criteria are followed, then certain benefits accrue to the property—and are recognized with credits. Because of the microscale and dispersed nature of LID designs, giving individual credits for individual practices becomes an accounting and logistical nightmare. In such cases the best approach is to aggregate the LID practices into one “bucket” and to presume that, if they are all in place, a certain benefit accrues to the property as a whole, which is credited. This means that there will need to be minimal LID design standards or, better, a performance criterion to be met.

Credit Based on Reduced Cost of Service

The provision of onsite detention or retention systems theoretically reduces the cost of service for a given city by reducing, at a minimum, flooding-related costs and maintenance efforts. Multiobjective systems may also reduce other stormwater management program costs. It is somewhat comparable to reduced electric or water utility charges for use of systems in off-peak periods. Capital costs are lower because smaller conveyance system sizes can be used downstream from the property and, perhaps, older systems need not be replaced. Maintenance costs are lower because, presumably, the peak or volume of flow is reduced and thus the velocity-volume impacts on structural members and natural beds and banks are also reduced. The actual determination of cost reductions for this type of structure is very difficult, and therefore rules of thumb are used.

A modification on this approach is to offer a specific credit for the provision of needed additional capacity with onsite systems. In effect a property owner obtains the credit due his neighbors by handling their runoff for them. This type of

credit works well in redevelopment situations where excess capacity exists on one site but not on others upstream.

Another cost reduction credit approach involves a recognition of the reduction of municipal responsibility by using private resources. For example, cities spend a certain number of dollars per acre on major and minor system maintenance. Larger properties that maintain their own systems or public systems to a certain acceptable standard reduce the city's cost by removing their large area from public responsibility. This can be recognized through a credit equal to the area they remove from the city's responsibility or the actual cost of service reduced.

To implement a mechanism like this it is necessary to (1) determine the city's projected cost per acre for the maintenance operations program, (2) determine a minimum area and type of area for which a property can apply for this credit based on the minimum size the city typically maintains, (3) determine acceptable maintenance standards, (4) determine a means of verifying that the property owner or manager has an internal grounds crew or a contract grounds crew and a specific maintenance plan that will result in a suitable service level, and (5) develop an inspection or other reporting method to ensure compliance.

In other cases the public education capability of local schools (and even churches in one case) is recognized and credited if the local entity meets basic standards in terms of student contact hours and curriculum content. In one situation the development of this kind of credit led to larger regional public education and outreach programs involving many schools and joint development of curriculum.

Another example is a provision of credit for those industries, schools, and other facilities that have and fulfill the conditions of an industrial NPDES permit for stormwater management. It is argued that they must perform extraordinary activities beyond those of other properties and should thus be credited. What is ignored in these cases is the basis for such industrial permits—these types of properties have higher rates of or more toxic pollutants than average properties and thus require an individual industrial permit.

How Generous Should the Credit Be?

Based on the foregoing discussion it is apparent that the impact or cost reduction types of credit have the most legitimate basis. This is because the basis for granting credits is related to the purpose the fee is levied in the first place. All other types of credit must rely on either unrelated bases or more tenuous logic to establish a credit. Once a cost reduction or impact reduction crediting mechanism is decided upon, its actual implementation then determines the types and amounts of credit offered. By choosing among different basic approaches, a local government can either limit or expand the portion of the fee available for crediting.

The generosity of the credit varies along a continuum from "Scrooge" to "Santa." Along that continuum there are mileposts. Let's discuss three of them.

Approach One—Development Bears Its Own Burden (Scrooge)

This approach recognizes the fact that large concentrated impervious areas (such as shopping malls or industrial sites) place a tremendous strain on the stormwater system at the point of release and downstream. It is further assumed in this approach that the stormwater utility fee is set to provide an average level of maintenance, capital improvements, and emergency response but is not designed to be able to mitigate impacts of the type experienced by the more intense developments. Such concentrated impervious areas would be considered well over this level. Detention or other controls are then required by the city to bring the impacts of a site to within some "norm" for development intensity, which can then be handled by the utility. It is considered a cost of doing business and should not be credited. For example, for peak flow control one city requires all developments to reduce peak flows to a level reflected by single-family half-acre lot development. Any detention structure that accomplishes only this minimum amount of peak flow reduction is not eligible for credit. Approved reductions beyond this level would be eligible.

Approach Two—Only Actual Cost Savings Belong to the Property Owner

In this approach actual cost savings (or an approximation of them) are credited to the property owner. Here it is recognized that much of the program cost is relatively fixed and only remotely related to actual impervious area. Any credit given should be applied only for those elements of the program where an actual public cost savings could be shown or implied. The link between the total fee paid and the total program cost is broken, and only part of the fee is eligible for consideration for credit. Typically this includes portions of maintenance operations, capital improvements, water-quality field operations, engineering, and regulatory services. One city made up to 65% of its program available for crediting using this philosophy, reserving the other 35% as "fixed" or "non-parcel specific" costs that all properties must bear. Such things as administration, general planning, finance and accounting, and general regulation might fit in this category.

The partial program option suffers somewhat from a break in logic in that, for most stormwater utilities, the *total* individual user fee is based on impervious area while only a *part* of the fee is available for crediting. It might be argued that if the fee goes up and down based solely on impervious area, so should the credit. One way to partially offset this from the rate

structure side of the equation is to charge a fixed cost per account for those costs that have nothing to do with property size or impervious area demands on the system or program. For example, the cost to send out a bill is the same for a large shopping mall and a single-family residence. Each would then pay the same for this portion of the total program cost. This has the effect, though, of shifting costs toward the smaller ratepayers. Another way is to base the charge on both total area and impervious area allowing a fee reduction on only the impervious area-based portion.

Approach Three—Credits Are Provided on the Same Basis as Fees (Santa)

This approach fully matches the premise used for justification of the user fee: impervious area as a surrogate for demand placed on the system. The fee charged goes to pay for all parts of the stormwater program, not just directly applicable capital or maintenance operations. A direct relationship exists between impervious area, total program costs, and the total fee. This approach both is consistent with the basis of most user fees and has an easily established physical connection. It also provides the largest of the credits under the impact-cost crediting basis (in one case up to 100% of the total fee). This approach recognizes that much of the program cost is not tied to impervious area (administrative, NPDES costs, planning, etc.) but chooses to apply the credit solely on the basis of the fee. The total fee is based on impervious area, so the credit is too. In this situation, limits are placed on the amount of credit granted through more stringent technical criteria. For example, in one city part of the credit (25%) was applicable to volume of flow increases but would only be available for true volume reductions through infiltration, evaporation, stormwater reuse or diversion, or stormwater collected in detention ponds and then pumped to the wastewater system for treatment and discharge to receiving waters.

Snappy Close

It is rare that a local government entity can offer flexible programs that recognize and reward good or extra-special behavior. Stormwater credits are such a capability. As such their value goes well beyond a simple cash-for-action transaction and gets at the heart of the growing new paradigm of sustainable or green development and the older paradigms of a well-designed and maintained stormwater system.

A local community can gain significant mileage through using a stormwater credit in conjunction with an education and recognition program, through cost share and demonstration projects, and through neighborhood group efforts. If done correctly these credits become one tool in the tool belt of the stormwater manager to promote sound development, aesthetically pleasing, environmentally friendly, functional, and well maintained.

Note

The section “Background and Theory” is based in part on Reese 1996.

Topics: BMP Post Construction, Program management

xx.xx.xxx Tree Species.

The following tables provide information on selected species of native and non-native trees suitable for planting in open space, forested, street tree, and ornamental landscape areas. Trees listed in the Native Trees table are most appropriate for use in native restoration areas, though some of the species are also appropriate for ornamental landscapes or as street trees.

Trees listed in the Non-Native Trees table are best used in ornamental landscapes. Some of the non-native trees are also appropriate for street tree use. In general, non-native trees should not be used in native restoration areas, though there are a few exceptions. Non-native trees that *are* considered appropriate in native restoration areas are noted in the table; however, some jurisdictions may prohibit all non-natives in native restoration areas.

All species listed are suited to one or more of the climate conditions found in the Pacific Northwest. Some of the species are best for wet or boggy sites and will not perform well on drier sites without plentiful supplemental irrigation. These trees are not recommended for landscapes where water conservation is a project goal, unless the site contains wetland or boggy areas with year-round moist soil conditions.

When choosing between native and non-native species, the landscape function of the plant materials should be considered. If the goal is to re-establish or supplement plantings in a riparian or wetland setting, the plant palette should be native. If the goal is to provide an open space or forested area with high stormwater management function, then a mix of native and non-native trees may be most appropriate. This is particularly true in suburban, urban, and subdivision settings outside of wetland or riparian areas and their buffers. The *LID Technical Guidance Manual for Puget Sound* (2005, pp. 58-59) provides the following plant palette recommendations for open space/forested areas to provide optimal stormwater management function:

- In the Puget Sound, coniferous evergreen trees provide the most year-round stormwater management function
- The plant palette should include a mix of species to minimize potential for plant disease
- Provide a multi-layer canopy of large trees, small trees, and shrubs. The mix should be approximately 50% large trees and 50% small to medium trees and shrubs
- A ratio of 2 evergreen trees to 1 deciduous tree will approximate native forest cover conditions for many Puget Sound sites that were previously forested. Unless native-only species are required for the site, it is acceptable to use non-native species to create this type of forest cover condition.

The tree lists provided here are for guidance only and are not intended to be all-inclusive. Other tree species may be utilized where appropriate when recommended by a professional forester, certified arborist, or licensed landscape architect. Species availability and quantity may be limited in some cases. For native species, it is best to coordinate in advance with nurseries specializing in native plants.

For bioretention areas, a complete list of appropriate plants can be found in Appendix 3 of the *LID Technical Guidance Manual for Puget Sound* (2005 or most recent).

Native Trees			
Species Scientific Name	Canopy Size Category ¹	Street Tree?	Characteristics
Grand fir <i>Abies grandis</i>	Large	No	Coniferous tree achieving heights of up to 150 feet. Tolerant of a variety of soil conditions, similar needs as Douglas fir.
Vine maple <i>Acer circinatum</i>	Small	No	Deciduous tree typically reaching heights of 5-35 feet. Treelike in open sun, crooked sprawling and viselike in shade. Good fall color. Tolerant of a wide variety of soil conditions. Prefers moist soils, but can tolerate drier conditions once established.
Big leaf maple <i>Acer macrophyllum</i>	Large	No	Deciduous tree. Form varies widely based upon competition and soil conditions. Typically 20 to 30 feet high when grow in open conditions but can reach heights of 80 feet or more in the forest. Good fall color. Tolerant of a wide variety of soil conditions. Similar environmental needs as Douglas fir. Available only in 5-gallon or smaller sizes
Red Alder, Oregon Alder, Western Alder <i>Alnus rubra</i>	Medium	No	Deciduous tree to 50 feet. Best in restoration settings. Mature trees can be very attractive, especially in naturalized settings. Beautiful, mottled grey bark.
Serviceberry <i>Amelanchier alnifolia</i>	Small	No	Deciduous tree seldom larger than 20 feet in height. Tolerant of a wide variety of soil conditions. Fruit very valuable to wildlife.
Madrone <i>Arbutus menziessii</i>	Medium	No	Attractive tree, but very difficult to establish. Expect high losses. Review plant establishment notes at www.soundnativeplants.com before considering. Do not provide supplemental water once established.
Weeping nootka cypress <i>Chamaecyparis nootkatensis 'Pendula'</i>	Small	No	Narrow (5'), pyramidal evergreen conifer. Main trunk grows straight up with branchlets that weep straight down from drooping branches.
Black hawthorn <i>Crataegus douglasii</i>	Small	No	Deciduous tree up to 30 feet in height. Scarlet fruit. Prefers highly fertile soil and grows best in moist, open areas.
Oregon Ash <i>Fraxinus latifolia</i>	Medium	No	Deciduous tree up to 80 feet in height. Prefers moist or wet sites with rich soils. Works well for streamside and wetland plantings. Best in natural or restoration plantings and generally not appropriate for ornamental landscaping applications.
Sitka spruce <i>Picea sitchensis</i>	Large	No	Coniferous tree achieving 80-160 feet. Best in moist areas.

Native Trees			
Species Scientific Name	Canopy Size Category ¹	Street Tree?	Characteristics
Shore pine <i>Pinus contorta</i>	Medium	No	Coniferous tree to 35 feet tall. Can be trained if a more manicured look is desired.
Western white pine <i>Pinus monticola</i>	Medium	No	Coniferous tree to 60 feet tall. Soil adaptable. Soft blue-green needles 2 inches long. Cones 5-10 inches long. Great specimen tree.
Black cottonwood <i>Populus balsamifera</i> spp. <i>trichocarpa</i>	Large	No	Heavy-limbed deciduous tree, brittle wood. Best in moist, native plantings where space is plentiful.
Choke Cherry <i>Prunus virginiana</i>	Medium	No	Needs well drained soil. Usually upright branching with an oval crown. Fragrant white flowers.
Douglas fir <i>Pseudotsuga menziesii</i>	Large	No	Fast growing, long lived coniferous tree growing to height of 150 feet or more. Prefers drier sites, but tolerates a wide variety of soil conditions.
Western crabapple <i>Pyrus (Malus) fusca</i>	Small	No	Best in native or restoration plantings and generally not appropriate for ornamental landscape use.
Cascara <i>Rhamnus purshiana</i>	Medium	No	Deciduous tree that produces black berries. Best in restoration settings.
Western red cedar <i>Thuja plicata</i>	Large	No	Coniferous tree growing to height of 150 feet or more. Best under moist, shaded conditions, but tolerates a wide variety of soil conditions once established.
Western hemlock <i>Tsuga heterophylla</i>	Large	No	Fairly fast grower, Picturesque and also makes a good background, screen, or hedge.
Notes: 1. Canopy size categories: a. Large: mature canopy area > 1,250 square feet b. Medium: mature canopy area 450 to 1,250 square feet c. Small: mature canopy area < 450 square feet			

Non-Native Trees			
Species Scientific Name	Canopy Size Category ¹	Street Tree?	Characteristics
Japanese Maple <i>Acer palmatum</i>	Small	Yes	Common deciduous landscape tree. Slow growing; typically grow to no larger than 20 feet in height. Well suited for small lot use. Popular varieties 'Atropurpureum' and 'Bloodgood'.
Norway Maple (varieties) <i>Acer platanoides</i>	Large	Yes	Common deciduous landscape tree. Typically achieves heights of 50 to 60 feet. Care must be taken near sidewalks and drives as roots can become a problem.
Red Maple <i>Acer rubrum</i>	Small	Yes	Common deciduous landscape tree. Varieties 'Armstrong' and 'Red Sunset' are recommended for street tree use. Fast growing, typically to 40 feet with brilliant fall color. May be appropriate

Non-Native Trees			
Species Scientific Name	Canopy Size Category ¹	Street Tree?	Characteristics
			in a native setting
Whitebarked Himalayan birch <i>Betula utilis</i> var. <i>jacquemontii</i>	Medium	No	Prefers rich, moist, well drained soil. Narrow tree with oval crown. Brilliant white bark. Yellow fall color.
Incense cedar <i>Calocedrus decurrens</i>	Large	No	Coniferous tree achieving height of 150 feet. Drought and wind resistant. Slow growth. Native to California, Nevada, Oregon. Appropriate for native restoration areas.
European hornbeam <i>Carpinus betulus</i>	Medium	Yes	Deciduous tree growing to 40 feet. Variety 'Fastigiata' recommended for street tree use.
Eastern redbud <i>Cercis canadensis</i>	Medium	Yes	Tolerates any soil but wet. Short trunk with spreading branches. Flowers appear before leaves. Heart-shaped leaves emerge reddish and turn dark green. Yellow fall color.
Katsura Tree <i>Cercidiphyllum japonicum</i>	Medium	Yes	Deciduous tree, slow growing to 40 feet. Good fall color. Well suited for small lot use.
Hybrid Western dogwood 'Eddie's White Wonder' <i>Cornus nutallii x florida</i>	Small	Yes	Hybrid of <i>Cornus florida</i> and the native western dogwood species. May be appropriate in a native setting. More successful than the native species for transplanting. Deciduous tree up to 30 feet in height. Prefers well-drained sites and partial shade. Could work well as a supplemental planting under a canopy of larger trees.
Washington hawthorn <i>Crataegus laevigata</i>	Small	Yes	Small deciduous tree, typically no larger than 25 feet. Well suited for small lot use with good fall color..
English hawthorn <i>Crataegus phaenopyrum</i>	Small	Yes	Small deciduous tree, typically no larger than 25 feet. Well suited for small lot use, but can be prone to disease.
White Ash (varieties) <i>Fraxinus americana</i>	Medium	Yes	Prefers deep, moist, well drained soil. Green leaflets turn to purple shades. Fall color may include yellow, orange, red, and dark purple.
Green ash <i>Fraxinus pennsylvanica</i>	Medium	Yes	Fast growing deciduous tree with height of 40 feet. For street tree use, seedless varieties such as 'Marshall' are preferred.
Honey locust <i>Gleditsia triacanthos</i>	Medium	Yes	Fast growing deciduous tree with height of 40 feet. Varieties 'Shademaster', 'Skyline', and 'Moraine' are preferred varieties.
American sweet gum <i>Liquidambar styraciflua</i>	Medium	Yes	Common landscape tree very tolerant of urban conditions. Achieves heights of 60 feet with good fall color.
Tulip tree <i>Liriodendron tulipifera</i>	Large	No	Large deciduous tree achieving height of up to 60 feet. Very tolerant of urban conditions.
Crabapple <i>Malus sp.</i>	Medium	Yes	'Red Jewel', 'Jade', 'Snowdrop' are good varieties.
Dawn redwood <i>Metasequoia glyptostroboides</i>	Large	No	A deciduous conifer. Fast growing. Bright green fern-like needles. Fall color ranges from bronze to apricot.

Non-Native Trees			
Species Scientific Name	Canopy Size Category ¹	Street Tree?	Characteristics
Sourwood <i>Oxydendron arboreum</i>	Medium	Yes	Medium deciduous tree with good fall color. Achieves height of 18 feet.
Yoshino flowering cherry <i>Prunus yedoensis</i>	Medium	Yes	Medium sized deciduous tree achieving height of 40 feet. Fast growing.
Flowering callery pear <i>Pyrus calleryana</i>	Medium	Yes	Widely used in commercial landscaping. Deciduous tree 25 to feet in height. Well suited to urban conditions. Varieties for street tree use include 'Aristocrat', 'Bradford', 'Capital', 'Chanticleer', 'Redspire' and 'Whitehouse'.
Pin oak <i>Quercus palustris</i>	Large	No	Deciduous tree achieving heights of 50 to 80 feet. Better suited to park or large lot use due to size.
Scarlet oak <i>Quercus coccinea</i>	Large	No	Oval to round canopy shape with high, open branching pattern. Bright green leaves turn scarlet in fall. Deep roots allow for lawn or perennial plant growth beneath canopy.
English oak <i>Quercus robur</i>	Large	No	Prefers well drained sites. Open form. Deep green leaves with yellow-brown fall color. Needs ample space.
Giant Sequoia <i>Sequoiadendron giganteum</i>	Large	No	A good choice in a landscape with adequate space.
Japanese snowbell <i>Styrax japonicus</i>	Medium	Yes	Needs well drained soil and ample water. Medium green foliage with yellow fall color. Blooms in June with fragrant white bell-shaped flowers.
Little Leaf Linden <i>Tilia cordata</i>	Small	Yes	Small deciduous tree reaching height of 30 feet. Tolerant of urban conditions.
Sawleaf zelkova <i>Zelkova serrata</i>	Large	No	Water well initially to establish deep roots. Once established, very drought and wind tolerant. Fall foliage varies from yellow to dark red. Smooth gray bark.
Notes: 1. Canopy size categories: a. Large: mature canopy area > 1,250 square feet b. Medium: mature canopy area 450 to 1,250 square feet c. Small: mature canopy area < 450 square feet			

Vegetated Roof Cover

Philadelphia, Pennsylvania



Key Concepts:

- Structural Control
- Retrofit Opportunity
- Volume Reduction
- Life Cycle Costs

Introduction

Vegetated roof covers on industrial and office buildings have been used in Europe for more than 25 years to control runoff volume, improve air and water quality, and promote energy conservation. These systems, known as “green roofs” or “extensive roof gardens,” also have aesthetic benefits. They typically include layers of drainage material and planting media on a high-quality waterproof membrane. These systems use foliage and a lightweight soil mixture to absorb, filter, and detain rainfall. Some of the conditions responsible for the promotion and acceptance of green roofs in Europe, which many American cities face as well, are

- Widespread implementation of stormwater-related fees or taxes
- Laws requiring mitigation or compensation for the elimination of open space
- Densely populated areas with high real estate values
- Requirements to reduce loads on combined sewer systems (CSSs)

Project Area

The demonstration project was installed on the roof of the Fencing Academy of Philadelphia (Figure 1). Like many urban areas on the East Coast, Philadelphia experiences frequent, small, high-intensity storm events. These short-duration events frequently overload and surcharge sewer systems. In the Philadelphia region, storms with 24-hour volumes of 2 inches or less contribute 90 percent of all rainfall. Vegetated roof covers are designed to control these

Project Benefits:

- Runoff Reduction
- Air & Water Quality Improvement
- Aesthetics
- Energy Conservation

high-intensity storms by intercepting and retaining water until the rainfall peak has passed, while also allowing larger storm events to be safely conveyed away from the building.

Vegetated roofs are complex structures that require consideration of the load-bearing capacity of roof decks, the moisture and root penetration resistance of the roof membrane, hydraulics, and wind shear.

The plants help recreate the hydrologic function of open space in the following ways:

- Capturing and holding precipitation in the plant foliage
- Absorbing water in the root zone



Figure 1. Fencing Academy of Philadelphia vegetated roof cover.

- Slowing the velocity of direct runoff by extending the flow path through the vegetation
- Cooling the temperature of the air and runoff. (Green roofs can be very effective measures for reducing the “thermal shock” caused by flash runoff from hot roof surfaces.)

Project Description

The vegetated rooftop project at the Fencing Academy of Philadelphia is a 3,000-square-foot vegetated cover installed and monitored by Roofscapes, Inc., on top of an existing structure (Figure 1). The roof system was intended to mimic the natural hydrologic processes of interception, storage, and detention to control the 2-year, 24-hour storm event. The distinguishing features of this system include

- Synthetic under-drain layer that promotes rapid drainage of water from the surface of the roof deck
- Thin, lightweight growth media that permits installation on existing conventional roofs without the need for structural reinforcement
- Meadow-like setting of perennial *Sedum* varieties that have been selected to withstand the range of seasonal conditions typical of the Mid-Atlantic region without the need for irrigation or regular maintenance

The installed vegetated roof cover is only 2.74 inches thick including the drainage layer. The system weighs less than 5 pounds per square foot when dry and less than 17 pounds per square foot when saturated. The saturated moisture content of the media is 45 percent by volume. The saturated infiltration capacity is 3.5 inches per hour. Figure 2 shows the components of the roof system.

The runoff characteristics of the roof were simulated using rainfall records for 1994 from eastern Pennsylvania. The model predicted a 54 percent reduction in annual runoff volume. The model also predicted attenuation of 54 percent of the 24-hour, 2-year Type II storm event and 38 percent of the 24-hour, 10-year Type II storm event. Additionally, monitoring at a pilot-sized project for real and synthetic storm events was conducted for a period of 9 months at 14- and 28-square-foot trays. The most intense storm monitored was a 0.4-inch, 20-minute thunderstorm. The storm event occurred after an extended period of rainfall had fully saturated the system. Figure 3 shows the runoff attenuation effectiveness for this event. Although 44 inches of rainfall was recorded during this period, only 15.5 inches of runoff was generated from the trays. Runoff was negligible for storm events with less than 0.6 inch of rainfall.

Project Summary and Benefits

This project showed that vegetated rooftop covers can help to reduce peak runoff rates for a wide range of storm events. The project also demonstrated that existing structures can be successfully retrofitted to help prevent CSS surcharging in urban areas. Significant energy

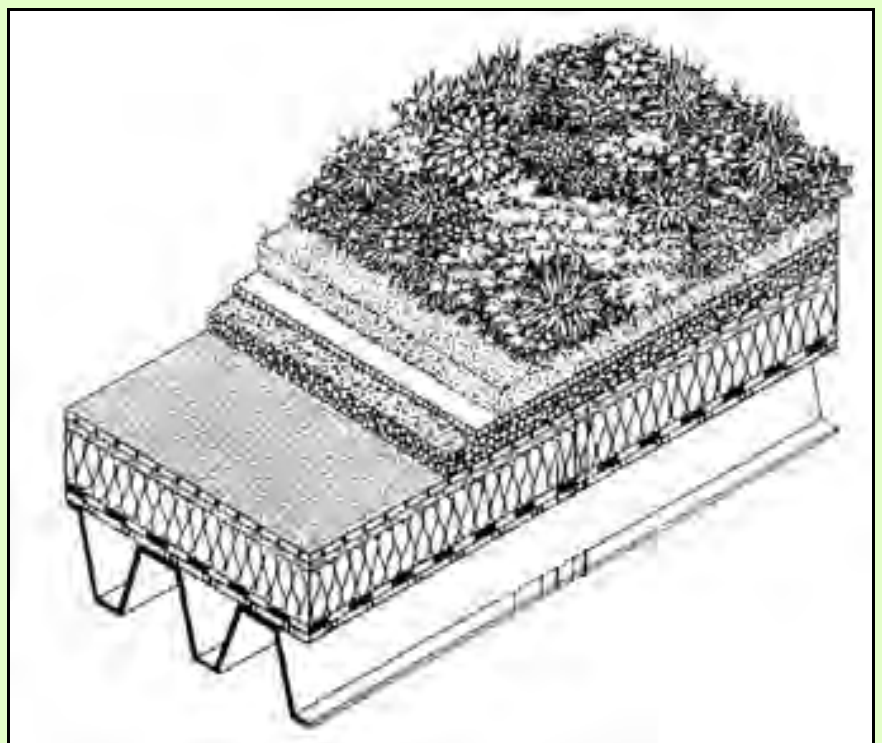


Figure 2. Components of the vegetated roof cover.

conservation benefits also are associated with vegetated rooftop covers. During the spring and summer, temperatures on a neighboring black tar roof varied by as much as 90 °F, while the variation under the 2.74-inch vegetated cover was only 18 °F. The vegetated cover also insulates the roof in winter, and the vegetation protects the roof membrane from the elements. Vegetated rooftop covers can potentially extend the life of a roof by 20 years or more.

References

Miller, C. 1998. *Vegetated Roof Covers: A New Method for Controlling Runoff in Urbanized Areas*. Pennsylvania Stormwater Management Symposium, October 21-22, 1998, Villanova University, Villanova, Pennsylvania.

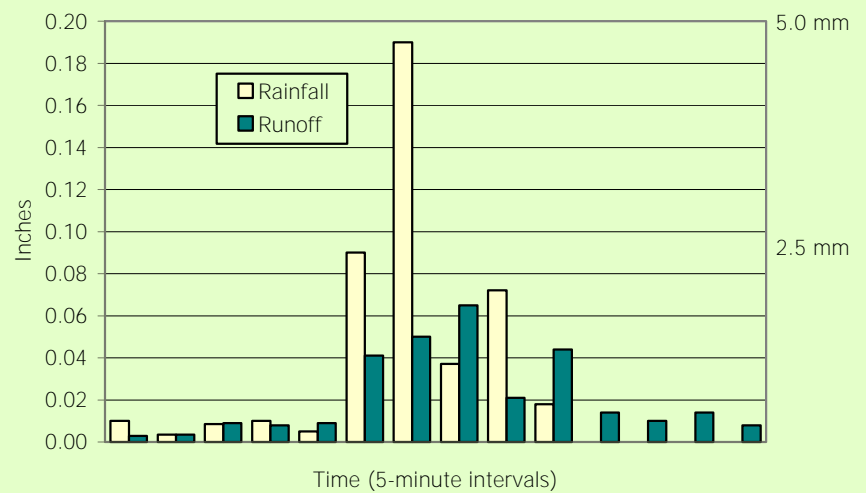


Figure 3. Runoff attenuation efficiency for a 0.4-inch rainfall event with saturated media.

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